HOROMETRIA:

Or the

Compleat Diallift.

Shewing, How to Calculate and Defcribe the Horizontal, and all Manner of Upright SUN-DIALS, either Direct, or Declining in any Latitude.

Alfo, An Eafie, New and Speedy Method, of Defcribing Hour Lines, on all the pleafant fortes by the SECTOR

To which is Annexed

TABLES

Calculated for the

Latitude of 51. deg 30 min.

Viz. LONDON.

An feveral other places in both Hemifpheres.

Containing the Hour Diftances, and Parts of an Hour from the Meridian, in all Decliners, from one Degree to 60 Degrees. With the Ufe of the Table.

By John Good, Teacher of the Mathematicks.

LONDON: Printed, for the Author, 1738.

TO THE
READER.

Courteous Reader.

IN the following Treatife, you have the
(long Promifed) Calculation of the
Hours, and Parts of an Hour from
the **Meridian**, in all **Declining Di**
al, for the Latitude of 51 : 30 from one De-
gree of Declination to 60; and from thence to
90 Degrees, you have an Excellent way of De-
neateing Sun Dials by the Sector.

I Prefume The Learned and Ingenious Di-
alifts have approved of thofe Tables that I have
ready Calculated in my **Art of Shadows,**
of the Hours, and Parts of an Hour from the
ubftile,) by the quick Sale of two Impreffions.
And I may without offence affure the Lovers
of Art, that thefe Tables are much Eafier, they
ving had the Approbation of feveral Diallifts
and Mathematicians And to comply with the
clire of feveral of my Friends and Acquaintance

have

Publiſhed them in the following Pages.

Likewiſe you have an Arithmetical way of Calculaʼeing all manner of Upright Sun-Dials, either Direct or **Declining**, in any Latitude, and to any Declination.

Alſo you have a **New Method** of Deſcribing Dials upon all the aforeſaid plains, by that Unparallelʼd **Inſtrument** the Sector. And by it how to find the Neceſſary Requiſites in Dialling. And I would have you Obſerve, that a Sector Proper for this Work, ought to be of no leſs Length than one Foot; becauſe the Lines of Chords, Sines, Tangents, and Secants are divided (if leſs than a Foot) but to every 30 minutes, whereas thoſe of a Foot long, are divided into 15 minutes, and than you may Eaſily Eſtimate every 5 minutes;

I ſhall ſay no more in Commendation of this Tract, but leave it to ſpeak for it ſelf, I remain a well wiſher to the Mathematicks &c.

JOHN GOOD.

A Description *of* DIALLING

DIALLING is an Art teaching how to Measure the time of the Day, by the shade of the SUN; and is Originally a Mathematical Science, attain'd by the Philosophical contemplation of the motion of the Sun, the motion of the shadow, the Constitution of the Sphere, the Situation of Plains, nnd the consideration of Lines.

The motion of the Sun is regular, it moving equal Space in equal Time; but the motion of the shadow irregular in all Parts of the Earth, unless under the two Poles, and that more or less according to the Constitution of the Sphere, and the Situation of the Plain.

And therefore by Art there is found out Rules to mark out the irregular Motion of the Shadow in all Latitudes, and on all Plains, to comply with the reguler Motion of the Sun. And these Rules of adjusting the Motion of the Shadow, to the Motion of the Sun, may Properly be called

The Art of S H A D O W S.

A Dial Plain, is a plain superficies, upon Which Hour lines are drawn in eti Latitude, and is distinguished in respect of the Horizon, into Parallel (as the Horizontal,) Perpendicular

as such as are set against an Upright Wall, or Building, which are of two sorts viz. either Direct or Faced one of the four Cardinal points of the Horizon; or Declining, and these are often called Mural Dials. Oblique Plains, are such as Recline, and are either Direct, or Declining.

Geometrical Problems.

Problem I. Fig. I.

Upon any Point (as O) taken in the Right Line Q R, to Erect the Perpendicular O S.

YOur Compasses being opened to any small Distance, and setting one Foot in the given Point O, with the other Foot make marks on both sides of O, as at T, and V.

Then open your Compasses to any distance greater than the former, and setting one foot in T with the other make the Arch hh : also, with the same distance set one foot in V, and with the other describe the Arch gg, crossing the former Arch in the point S, then draw the line O S, and it will be Perpendicular to the given line Q R.

Problem II. Fig. II. A Right line given, how to draw a line Parallel thereunto at any distance required.

LET the line given be AB, unto which is required to draw the right line C D, Parallel to the former line AB, at the distance A C.

Open your Compasses to the Distance A C,

then

er set one Foot in the Point A, with the other
describe the Arch C; Again, place one Foot
B, and with the other describe the Arch D, then
aw the Line CD so that it may only touch the
o Arches C and D, so shall the Line CD so
awn, be Parallel to AB, and at the distance
quired.

Problem III. Figure III.

e *Latitude* of *the Place, the Declination* of *th*
Sun, and *the A'titude* of *the Sun being given,*
to find *the* Azimuth *Geometrically.*

	deg.	min.	
The Lati. of the place is	51	30	
The Decli. of the Sun is	20	9	North.
The Alti. of the Sun is	18	2	

I. Upon the Center Q, describe the Semicircle
Z O for half the Meridian, and upon Q, raise
e Perpendicular QZ, for the zenith.
2. Set 51 deg. 30 min. of your Line of Chords,
nich is the Latitude of London, from Z to Æ,
d draw Æ Q for the Equinoctial.
3. Set 20 deg. 9 min. the Sun's Declination,
om Æ towards Z, to the Point D, (being it is
orth) and draw the Line DT parallel to Æ Q,
is DBT the Parallel of the Sun's Declination.

4.

Set 13 deg. 2 min. the Sun's Altitude give
from O to L, and from H to M, and draw a
Line ML, for the Parallel of Altitude.

5. Take in your Compasses, half the length
of the Parallel of Altitude SL, or SM; and with
that Distance upon Q, describe the innermost Se-
micircle ACG.

6. From the Point B, which is where the Pa-
rallel of Declination, and the Paralel of Altitud
do intersect, erect the Perpendiculer BC, till
touch the innermost Semicircle.

7. Lay a Ruler from Q to C, and it will c
the outermost Circle in E; so HE measured upo
a Line of Chords will be 80 deg. the Sun's Az
muth from the North part of the Meridian.

8. EZ shall be 10 deg. the Azimuth from t
East or West.

9. Lastly, EO shall 100 deg. the Azimu
from the South part of the Meridian.

Note, There is throughout this Book a con
tinual mention made of Degrees and Minute
know, that a Degree is the 360th part of a
Circle, each of which Degrees is supposed
be divided into 60 Parts called Minutes, so th
45 Min. is three quarters of a Degree, 30 Mi
half a Degree, and 15 Min. one quarter o
Degree, &c.

A Table of the Sun's Declination.

Days	January. d.	m.	Februa. d.	m.	March. d.	m.	April. d.	m.
1	21	44	13	46	3	24	8	36
2		33		26		0		58
3		23		5	2	37	9	20
4		13	12	45		13		42
5		2		25	1	49	10	4
6	20	50		3		25		24
7		38	11	43		1		45
8		26		21	0	38	11	0
9		13		0	0	14		27
10		0	10	38	0	10		47
11	19	46		16	0	33	12	7
12		32	9	54	0	57		28
13		18		32	1	21		48
14		3		10		44	13	7
15	18	48	8	46	2	8		27
16		32		25		31		40
17		17		3		54	14	5
18		2	7	4	3	18		25
19	17	45		17		41		42
20		28	6	54	4	5	15	1
21		11		31		28		19
22	16	54		8		51		37
23		36	5	45	5	14		55
24		18		21		37	16	12
25		0	4	58	6	0		29
26	15	42		34		22		50
27		24		11		45	17	2
28		4	3	47	7	7		18
29	14	45		39		30		34
30		26				52		50
31		6			8	14		

South | North

A Table of the Sun's Declination.

Days	May d.	m.	June d.	m.	July d.	m.	August d.	m.
1	18	5	23	12	22	8	15	11
2		20		16		9	14	55
3		35		19	21	51		36
4		50		22		42		17
5	19	4		25		32	13	58
6		18		27		22		39
7		31		29		12		19
8		44		30		2		1
9		57		31	20	51	12	4
10	20	10		32		40		19
11		22		31		28		
12		34		31		16	11	4
13		45		30		4		19
14		56		29	19	51	10	
15	21	7		28		38	10	39
16		17		26		25		18
17		27		23		12	9	57
18		37		20	18	58		36
19		46		17		43		
20		55		14		23	8	58
21	22	4		10		14		
22		12		6	17	59		
23		20		1		44	7	47
24		27	22	55		28		29
25		34		50		11		
26		41		44	16	56	6	4
27		47		37		39		
28		53		31		22	5	5
29		59		24		6		
30	23	3		16	15	48	4	
31		8				30	4	

A Tbale the Sun's Declination

Days	Septem. d.	m.	Octb. d.	m.	Novem. d.	m.	Decem. d.	m.
1	4	24	7	15	17	40	23	9
2		2		58		56		13
3	3	38	8	0	18	12		17
4		15		21		28		20
5	2	52		45		43		23
6		29	9	7		58		26
7		5		29	19	13		28
8	1	42		51		27		30
9	1	19	10	13		41		30
10	0	55		33		55		30
11	0	32		56	20	8		30
12	0	8	11	18		21		30
13	0	16		39		34		30
14	0	39	12	0		46		29
15	1	3		21		58		27
16		26		41	21	9		24
17		50	13	2		20		21
18	2	13		22		31		19
19		37		42		41		15
20	3	0	14	2		50		13
21		25		21	22	0		9
22		47		41		9		4
23	4	10	15	0		15		0
24		34		19		17	22	57
25		57		37		33		51
26	5	20		55		40		44
27		46	16	1		46		27
28	6	6		3		51		30
29		29				58		21
30		52	17	6	23	04		15
31				28			21	56

North. South.

Problem IV. Figure IV.

How to draw a Meridian-line on an Horizontal Plane.

THe beſt time to find a Meridian-line, will be at ſuch a time as the Sun is between the Eaſt and the South, or between the South and the Weſt. Therefore make uſe of any time between 8, and 11 in the morning, or between 1, and 4 in the afternoon. In the Winter, in this Latitude the Sun Riſeth not till 13 min. paſt 8 ; at which time from 9 to 11, and from 1 to 3.

With 60 deg. of your Line of Chords deſcribe the Circle AB C D, then (turning your face to the Sun) holding up a thread and plumnet between your Plane and the Sun, ſo as the ſhadow of the thread may paſs through the Centre O, I draw the line Sha————dow ; at which time it was 40 min. paſt 10 in the morning, on April the 14th. the Altitude of the Sun being 48 : 13 and his Declination as you may ſee by the Table in page 6) 13 : 07, the Latitude 51 : 30 , then by the laſt Problem get the Sun's Azimuth, which will be 30 dgrees ; then becauſe your Obſervation of your Shadow-line was in the morning, ſet 30 degrees the Sun's Azimuth, from that end of the ſhadow-line marked with Sha, towards the Right-hand, as to B, and draw the line BOD, for the Meridian-line. But if your Obſervation be in an Afternoon, the Azimuth muſt be ſet towards the Left-hand.

Horometria

HOROMETRIA:

Or the Compleat

DIALLIST.

CHAP. I.

*y to Calculate an Horizonial Dial, whose Plane
at, and is parallel to the Horizontal.*

efore we come to the Calculation of the Horu-
nces, draw the Meridian Line CAB, and cross the
e with the Line DE, at right Angles, in the Point
which Interfection muft be the Centre of the Di-
and the Line fo drawn viz. DE is the Six Clock-
e, then to draw to draw the other Hour-Lines fay,
As the Radius, is to the Sine of the Pole's Elevation:
the Tangent of the Hour-Lines at the Pole, To
the

the Tangent of the distance of the Hour-Lin
from the Meridian.

First, theirfore prepare a Table, according t
the Example adjoyning wherein fet down all th
Hours in order from 12, as they are equidiftan
from the Meridian. viz. 11 and 1, 10 and 2,
and 3 &c. unto them Adjoyn the Equinocti
diftances, that is, for the firft Hour 15 degre
for the fecond Hour 30 deg. for the third Ho
45 deg. and fo of the reft by, continnal addit
on of 15 deg. then take out of your Table
Logarithms,(and fet on a loofe Paper) the Ar
ficial Sine of the Elevation of the Pole above th
Plane, which for 51 d. 30 m. is 9. 893544 an
is always one of the middle Portionals, in find
ing out every Hours diftance apply it to the Lo
tangent of 15 deg. 9. 428052, (which is th
firft Hours Equinoctial diftance) and add then
both together, there fhall come forth a new Log
tangent of 19. 321596, for that hours diftance
which fet down in the Table by 15 d. then m
move your Paper, to the Logar. tangent of 30
deg. and add them both together you fhall pr
duce a new Logar. tangent of 19 893544 for
the hours of 2 and 10, which fet down in th
Table by 30 de. Work after the fame manner
with the Logar. Tangent 45, 60, 75, deg. for
the reft of the hours.

A Tabl

A Table of Hour Distance.

Hours.	Equin. distan-ces.		The Logar thm of the iTangents.	The new Log. of the Tangnts.	The tr. hour diftanc.	
	d.	m.			d.	m.
xii	00	00	0 .000000	0. 000000	00	00
xi i	15	0	9. 428052	19.321596	11	50
ii	30	00	9. 761436	19.654982	24	19
iii	45	00	10 000000	9 893544	38	03
iii iiii	60	00	10 238566	10.132105	53	36
i v	75	00	10.571917	10.495491	71	06
vi	90	00	Infinite.	Infinite.	90	00

The Canon for Calculation is,

the Radius or Sine 90 degrees	10.000000
o the Sine of the Latitude 51 30	9. 893544
is the Tangent of 15 degrees	9. 428053
the Tangent of 11 deg. 50 min.	19.321596

Which 11 50 is the diftance of the firft hour
from the Meridian namely xi and 1.
Work after the fame manner with the Tangent
30 degrees 45 deg. 60 deg. and 75 deg. for the
of the hours.

Now

Now if you dsign to put into this Dial, or any of the rest that follow, the half *Hours* and Quarters, their distances upon the Plane are as easily found by the same Rules, as the *Hours* were, for by adding the Log. Sine of the height of the Pole, or Stile unto the Log. Tangent of 3 deg. 45 min. 7 deg 30 min. and 11 deg. 15 min. which are the Equinoctial distances of half hours and quarters, there will come forth the Log. Tangents of new distances, proper to the halfs and quarters.

Thus you have all the hours-lines; but for the Drawing of it take the directions following.

Take with your Compasses 60 deg. from a line of Chords, and the same Extent. setting one Foot in the Centre A, with the other describe the Circle D O E, which done, take from the same Scale of Chords, all the Hour-distances, and placing one foot of your Compasses in O. (where the Circle Intersects the Meridian) with the other set out the Hour distances before found by Calculation, both ways upon the Circle D O E, then drawing streight Lines from the Center A, to those Points in the Circle, you shall have the true hour-lines desired.

Lastly, From the said Line of Chords, take the
Pole's

Pole's Elevation 51 deg. 30 min. and set from
O to P, drawing the line APH, for the Stile; so
will NAH be the true pattern of the Stile, or
Gnomon of your Dial, which erect at right An-
gles over the 12 a Clock Line, and so your
Dial is finished.

CHAP. II.

How to draw an Horizontal Dial by the SECTOR.

IRST, draw the Line CAB, for the
Hour-Line of 12, and cross it with
the Perpendicular DAE, for the Hour-
Line of 6, A being the Center of your
Dial; then in proportion to your Plain determine
AB, to be Radius, that is, take in your Compasses
the length of the Line AB, setting one foot in
45 deg. of your greater Tangent on your Sec-
tor, open the other Leg of your Sector untill the
other foot of your Compasses falls on 45 ; then
take out the Sine of the Latitude (of the place,
for which your Horizontal Dial is made for
which let it be 51 deg. 30 min.) to the same
Radius, and set from A to D, and E then setting
one foot in B, with the same extent sweep the
touch

touch of an Arch at I and G, then take the length
of the Radius AB, and setting one foot in D
weep the touch of an Arch at I, Intersecting the
former, also setting your Compasses in E, make
the like at G, and through the Points of Intersecti-
on, draw the streight lines EG. DI. and GBI, and
they will make a right angled Parallellogram,
the sides whereof will be Tangent lines.

To draw the Hour-Lines.

Make BG, or BI Radius, that is, take with
your Compasses the length of BG, or BI, setting
one foot in 45 of your greater Tangent, open the
other leg of your Sector till the other foot falls
in 45 deg. (this I call a Parallel distance then take
the Parallel distance of 15 deg. and set from B
towards G and I, for the hours so 11 and 1, and
the Parallel distance of the Tangent of 30 deg.
and set from B towards G and I, for the hours
of 10 and 2, and draw lines through the Points
G and I, and there will be 3 hours drawn on
each side the Meridian-Line.

Again. make DI or FG Radius, and take out
the Parallel distance of the Tangent of 15 deg.
and prick down from F to 5. and from D to
7; then take the Parallel distance of the Tangent
of 30 deg. and set it from F to 4. and from D
to 8, and draw lines into the Center, and so the
hour line

Work after the same manner with the Tangent of 30 deg. 45 deg. 60 deg. 75 deg. for the rest of the Hours.

Hours.	Equi'n distan.	Hour Arches.
12		00 00
11 01	15 00	09 28
10 02	30 00	19 46
09 03	45 00	31 54
08 04	60 00	47 09
07 05	75 00	66 43
06 06	90 00	90 00

The distance of each hour - line from 12 a Clock being found, you must Project them into the Dial after the same manner as was shewed in the Horizontal Dial, only for the height of the Stile you must take the Complement of the Latitude of the Place, 38 d. 30 min. and then work as before, only draw not the hours of 4, and 5, in morning, nor 7, and 8 at Night. Observe Figure B.

How to draw a South Dial by the SECTOR.

Having drawn A B. the Meridian, and crossed it with the Perpendicular D A E, for the hour line of 6, dertermining A B, Radius, of any length, take out the Sine of 38 : 30, the Complement of the Lat. to the same Radius, and set it from A, to E, and D, then you may finish your Dial as you did the Horizontal, making B G, B I, E G, and D I, Radius, a d your Stile must make an Angle of 38 : 30.

CHAP. IV.

hour-lines are finished, and for those that fall above the 6 of the clock line, are drawn by extending the two opposite hour-lines thro' the Center, as 4 in the morning is drawn by extending 4 in the Afternoon, &c.

The Stile must make an Angle with the Meridian equal to the Latitude of the place, which in this example is 51 deg. 30 min. and must stand at Right Angles with the Plain upon the 12 Clock Hour-line.

CHAP. III. Fig. B.

To describe the Erect South Dial, whose Plain stands upright, and directly beholds the South.

THE making of this differs very little from the Horizontal, only in the Calculation part, you took the Poles Elevation, but here you must take the Complement, and insert only hour as will appear by the figure.

Let the Question be to Calculate the distance of 11, or 1, a Clock from the Meridian; in the Latitude of 51 deg. 30 min.

The Canon for Calculation is.

As the Radius 90 degrees — 10.00000
Is to the Cosine of the Lat. 51 : 30 — 9.79414
So is the Tangent of 15 degrees — 9.42805
To the Tangent of 9 : 28 — 19.22210

Which 9 : 28 min. is the distance of the first hour from the Meridian, namely 11, and 1.

Wor

CHAP. IV.   *Fig.* 5.

How to draw a Direct North Dial.

A Direct North Dial, is the same with the
South Dial; for if you take a South Dial
and turn it upside down, causing the Stile
point upwards, as the Stile of the *South* doth
ownwards, and leaving out the Hours near the
Meridian, in these Northern Latitudes: as the
Hours of 9, 10, 11, and 12, at night, and 1,
, and 3, in the Morning, all which time the
un is under the Horizon. I say a South Dial so
iverted, and fixed against a direct North Wall,
all give the true hour of Day.

CHAP. V.   *Fig.* 6.

How to draw Hour-Lines upon a direct East or West Dial, Arithmetically.

L ET there be an East Dial, whose breadth is
6 Inches; and it is required to put on all the
our-lines from 6 in the Morning till 1 at Noon,
ere you have 5 hours and 6 Inches. Therefore
efore you can work the Operation, you must

<div align="right">turn</div>

Fig 5
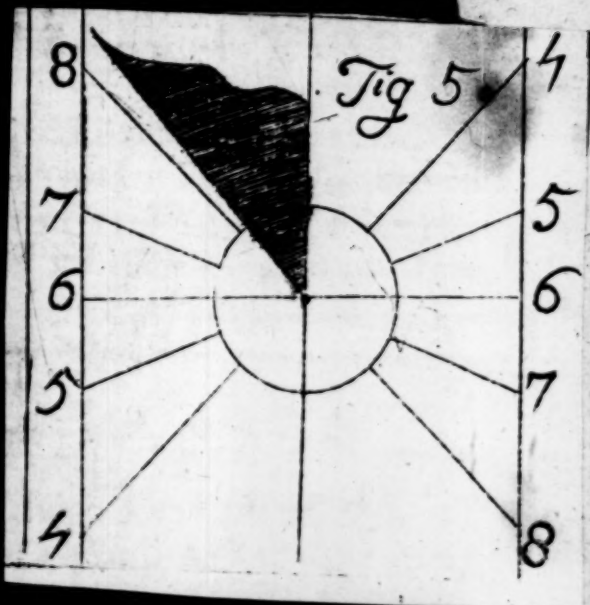
turn the hours into Degrees, by allowing for every hour 15 degrees, so you have 75 degrees for 5 hours; then turn the Inches into Parts, by allowing 100 Parts to every Inch, so you will have 600 Parts.

I. For the height of the Stile.

As the Radius 90 degrees   10.00000
Is to the Co-Tan. of 5 hours 75 deg.   9.42809
So is the Log. of the dist. from 6, 600 2.77815
To the Log. of the Stiles height 161 12.20624

That is 1 Inch, 61 parts of an Inch, an Inch divided into 100 Parts.

II. For the Hour-Lines distance from 6.

The Canon for Calculation is,
As the Radius 90 degrees   10.00000
Is to the Log. of the Stiles height 161 2.20683
So is the Tangent of 15 degrees   9.42805
To the Log. of 43 Parts for 7 a Clock 11.63488

As the Radius 90 degrees.   10.00000
Is to the Log. of the Stiles height 161 2.20683
So is the Tangent of 30 degrees   9.76144
To the Log. of 93 Parts for 8 a Clock 11.96826

As the Radius 90 degrees;   10.00000
Is to the Log. of the Stiles height 161 2.20683
So is the Tangent of 45 degrees   10.00000
To the Log. of 161 P. for 9 a Clock 12 20683

As the Radius 90 degrees.   10.00000
Is to the Log of the Stiles height 161 2 20683
So is the Tangent of 60 degrees   10.23856
To the Log. of, 279 P. for 10 a Clock 12.44539

As the Radius 90 degree.   10 00000
Is to the Log. of the Stiles height, 161 2.20683
So is the Tangent 75 degrees,   10.57194
To the Log. of 609, P. for 11 a Clock 12.77877

Having thus far proceeded, that 5 *Hour* from is Calculated, namely, 7, 8, 9, 10, 11, there are yet 4 and 5 in the Morning that must be drawn the same distance from 6 in the Morning, as 7 and 8 are; therefore, for your better Instructions, see Figure 6, and imitate this Geometrical Construction.

First, Square out your Dial, and draw the Line DAC, towards the bottom of the Plain; then with 60 degrees of Chords in the Point C, on the edge of the Dial, describe a part of a Circle as AB, and set from A, to B, the Complement of your Latitude 38 deg. 30 min. and draw the

Line

Line CEE, thro the Plane for the Equinoctial.

Secondly, Have recourse to your Table, and take, in your Compasses, the distance in Parts between 6 of the Clock and 11, namely 600, and make Marks with both feet in the Equinoctial for the *Hours* of 6 in morning and 11, but remember to leave room above 6, for 4 and 5 in the morning, then take in your Compasses 43 Parts, and set from 6, to 7, and 5, then take 93 Parts, and set on the Equinoctial from 6 to 8 and 4; then take 161, and from 6 in the Equinoctial to 9; Lastly, take 279 Parts, and set from 6 to 10. and thro' the Points in the Equinoctial draw Perpendiculars, and they shall be the true hour-lines.

Note, the Stile must be the breadth of 6 and 9 of the Clock, as you see in the figure, and must stand Perpendicularly in the hour-line of six of the Clock.

iv	093
v	043
vi	000
vii	043
viii	093
ix	161
x	279
xi	600

Note, if you have a mind to draw the Quarters and half Hours, and Three Quarters, you may if you observe the directions of the first Chapter, Page. 12.

Note.

Note, That If you turn
East Dial drawn on pa-
them you, and look on
back-side you shall see
perfect form of a Weft
, only in stead of the
urs 11, 10, 9, 8, 7, 6
, you must write 1, 2,
5, 6, 7, and 8.

this Table you have
Parallel distance of e-
Quarter of an hour
e direct East or West

Hours.		Parts
IV	viii	092
1	3	079
2	2	067
3	1	054
V	vii	043
1	3	032
2	2	022
3	1	011
vi	vi	000
1	3	011
2	2	022
3	1	032
vii	v	043
1	1	054
2	3	067
3	3	079
viii	iiii	093
1	3	108
2	2	124
3	1	141
ix	iii	161
1	3	181
2	2	210
3	1	240
x	ii	279
1	3	324
2	2	383
3	1	503
xi	i	600

A Table shewing the distance of every quarter in the Horizontal Dial, Latitude 51 30			A Table shewing distance of every ter in the direct Dial, Latitude 5		
Hours.		D. M.	Hours.		D.
xii		00 00	xii		00
1	3	02 57	1	3	02
2	2	05 53	2	2	04
3	1	08 51	3	1	07
i	xi	11 51	i	xi	09
1	3	14 52	1	3	11
2	2	17 58	2	2	14
3	1	21 07	3	1	17
ii	x	24 19	ii	x	19
1	3	27 37	1	3	22
2	2	30 59	2	2	25
3	1	34 29	3	1	28
iii	ix	38 03	iii	ix	31
1	3	41 45	1	3	35
2	2	45 35	2	2	39
3	1	49 31	3	1	42
iiii	viii	53 36	iiii	vii	47
1	3	57 48	1	3	51
2	2	62 10	2	2	56
3	1	66 34	3	1	61
v	vii	71 06	v	vii	66
1	3	75 45	1	3	72
2	2	80 27	2	2	78
3	1	85 14	3	1	83
vi		90 00	vi		90

For the Geometrieal Construct of the two last
Tables, take the directions of the first Chapter.

CHAP. VI.

How to Place an Upright Dial truly.

ALL Upright Dials, in what Latitude so-
ever, have the Meridian perpendicular to
the Horizon, Therefore to set your Dial
exact, hang a Line with a Plummet at the end
thereof, upon a nail fixt in the hour-line of 12
towards the top; then apply your Dial to the
place where it is to be fixt, so that the line and
plummet may hang just down upon the line of 12
The Dial thus fixt (if the Declination be truly
taken, and the Dial made by the former directi-
ons)will at all times (if the Sun's on it) give
the true hour of the day.

Note, In every Dial truly placed, if you stand
on the South-side of the Plane looking North-
ward, the hours on your left-hand of the Me-
ridian, are the Morning hours, on your right-hand
are the Evening hours ; but if you stand on the
North-side of the Plain, your Face being South-
ward, then the Forenoon hours are on your right-
hand, and the Afternoon-hours on your left ;
because your right hand, in relation to the Plain,
is where your left-hand was.

<div align="right">CHAP.</div>

CHAP. VII.

How to find the Declination of any Plain,
from the South or North, towards the
East or West.

THE Declination of a Plain is an Arch of
the Horizon comprehended between the
Pole of the Plane and the Meridian of the Place.
Or it is the distance of the Plane it selfe, from the
prime Vertical Circle, or Azimuth of East and
West.

To find out the Declination of any Plane,
there are required two Observations to be made
by the Sun at the same instant of time. The first
of the Sun's Horizontal distance from the Pole
of the Plane, and Secondly, of the Altitude of
the Sun.

First, to find the Sun's Horizontal Distance
from the Pole of the Plane. Apply one edge of
a Quadrant, to to the Horizontal Line of your
Plane, so that the other may be Perpendicular to
it, and the limb of the Quadrant towards the Sun,
and hold the whole Quadrant Horizontal as near
as you can conjecture: Then holding up a Thread
and Plummet, at full Liberty, so that the Shadow
of the Thread may pass both thro' the Center

and

nd Limb of the of the Quadrant, obferve then
he Degrees cut by the Shadow of the Thread ,
nd number them from that fide of Quadrant
at fandeth fquare or Perpendicular to the Plane
or thofe Degrees are the Horizontal Diftance
quired .

Secondly, This Horizontal diftance and the
un's Altitude being obferved at the fame time
as near as may be) will help you to the Planes
eclination in this manner.

When you make your Obfervation, of the
un's Horizontal Diftance , mark whether the
hadow of the Thread , fall between the South,
nd that fide of the Quadrant which is Perpen-
 cular to the Plane.

I. If the Shadow fall between them, the Azi-
uth and Diftance Added togther do make the
eclination of the Plane, and in this Cafe the
eclination is upon the fame Coaft whereon the
un's Azimuth is.

II. If the Shadow fall not betwen them, fub-
act the leffer of them from the greater, and the
remainder fhall be the Plane's Declination; and
he Azimuth be the greater of the two , the
ane Declines to the fame Coaft whereon the
un is; but if the Diftance be the greater , then
e Plane Declines to the contrary Coaft.

And here Note , that the Declination thus
found

found is always accounted from the South, and that all Declinations are accounted from the South or North, towards either East or West, and must never exceed 90 Degrees.

I. If the Degrees of Declination do exceed 90, you must take the residue of that Number to 180, and that shall be the Plane's Declination from the North.

II. If the Degrees of Declination exceed 180 degrees, then the excess above 180 degrees gives the Plane's Declination from the North towards the Coast, which is contrary to the Coast whereon the Sun is.

But seeing the Declination is the Angle contained between the Perpendicular from the Wall and the Meridian, it may be best to wait in fair Weather, till you find the Sun in the Meridian; and then the Angle upon the Limb of the Quadrant, will it self be the Declination.

CHAP. VIII.   *Fig. 7.*

How to Calculate, and draw Hour-lines upon a South or North Dial Declining either East or West to any Declination, and in any Latitude.

BEFORE

BEFORE the Hour-lines can be drawn up on any of those Planes, two things must be given, and three other things must be found. The things given are,

1. The Latitude of the Place,
2. The Declination of the Plane,

The things that must be found are,

1. The Substiles distance from the Meridin, or 12 a Clock Hour-line.
2. The height of the Stile above the Plane.
3. The Planes difference of Longitude.

Example, Suppose that in the Latitude of London 51. 30. it were required to draw a Dial 25 deg. of Declination Westwards.

The Cannon for Calculation

As the Radius 90 degrees.   10.00000
Is to the Sine of the Declinati. 25:00 9.62595
So is the Co-Tang of the Lat. 51:30 9.90060
To the Tang. of the Sub. dist. 18:33 19.52565

As the Radius 90 degrees.   10.00000
Is to the Co-Sine of the Decli. 25:00 9.57228
So is the Co-Sine of the Latit. 51:30 9.79415
To the the Sine of the Sti. hei. 34:21 19 75143

As

As the Radius 90 degrees,　　　　10. 00000
To the Co-Tang. of the Decl. 25 : 00 10. 00000
So is the fine of the Latitude 51 : 30 9. 89354
To the Co-Tangent of　　　30 : 47 10. 22587
Which is the Planes Longitude.

East Dial.	West Dial.	Equinoctial distances.		Hour distances from the Subfiile.	
		d.	m.	d.	m.
iii.	ix.	75	47	65	49
ii.	x.	60	47	45	16
i.	xi.	45	47	30	07
	xii.	30	47	18	33
xi.	i.	15	47	09	04
x.	ii.	00	47	00	02
Subftile.	Subftile.	Subftile.		Subftile.	
ix.	iii.	14	13	08	08
vi.	iiii.	29	13	17	31
vii.	v.	44	13	28	47
	vi.	59	13	43	28
v.	vii.	74	13	63	24
iiii	viii.	89	13	88	51

Having proceeded, thus far prepare a Table of Hours fit for the Plane, such as is here done. Then against xii fet the Plans Difference of Longitude 30 degrees 47 min. (in the fecond Column) and from it fubtract 15 de. and their will remain 15 deg. 47 minutes which muft be fet against xi and i. Then fubtract 15 degrees and

d there will remain only 47 min. which set
ainst x and ii. Then becaule 47 min. is less
n 15 degrees, write the word Subftile under
nd Subftract it from 15 deg. their will re-
in 14 deg. 13 min. which set against ix and
Then to 14 : 13 add 15 deg. it maketh 29d
which set againft viii, and 4. Then add 15
g. it maketh 44 : 13, which set against vii and
Then 15 deg. more makes 59 : 13. which set
ainft vi, then 15 more makes 74 : 13 which
against v. and vii. Then 15 more makes 89
g. 13 min. which set against viii ann iiii ha-
g finished your Table on this side of 12 a
ock, I begin again at 12 and add 15 it makes
: 47, which set against i, and xi. and 15
ors makes 60 : 47 which set against ii, and x
d 15 more makes 75 : 47. which set against
, and ix. And thus you have made a Table
for Calculation, for finding the true Hour-
ftances on the Plane.

The Cannon for Calculation is,

s the Radius 90 degrees.   10.00000
to the Sine of the Stiles H. 34 : 31 9.75149
is the Tan. of the Equi. dift. 14 : 13 9.40372
the Tangent of   08 : 03   19.15521
Which is the diftance of 9 and 3 of
e Clock from the Subftile.
And fo will the Tangent of the next Equi.
octial diftance, 29 : 13, be to the Tagent of
7 : 31, for the diftance of the Hour-line of 8
                                                    and

and 4, from the Subſtile, and for the reſt of
Hours, as in the Table.

The Geometrical Conſtruction.

First, draw the Horizontal line B C, (as
figure 7) and from the middle of the line B
as at A ; let fall the Perpendicular A H, wh
ſhall repreſent the Meridian, Line of the Pl
Then take 60 Deg. of Chords, and making
the Centre, draw the Semicircle, B S C. In
Circle from Q to S prick down the diſtance
the Subſtile from the Meridian, which was fou
before 18 : 33, and from the Subſtile S, in
ſame Circle, I ſet off the height of the Stile
O, 34 : 21, ſo ſhall S A O repreſent the Co
of the Dial. Then from the ſame Scale of Chor
take off with your Compaſſes, the ſeveral Ho
diſtances, as they are ready Calculated in the T
ble, viz. 00 : 02 for 2 a Clock ; 09 : 04 for
a Clock ; 18 : 33, for 12 a Clock ; and 3
07, for 11 a Clock ; and ſo of the reſt, and pr
them down from the Subſtile, in the Circle B
C, by help of your Line of Chords. Laſtly, dr
ſtreight Lines from the Centre, A thro' the
ſeveral Points, and you ſhall have the true Ho
Lines, which was deſired.

Thus have finiſhed your dial, and in maki
of this you have made a South Declining Eaſt
25 de

25 deg. also; for if you turn the Paper and look through it, it will on the back-side be a South declining East, 25 deg. only the Afternoon in this, must be the Forenoon hours in that.

Note, If the Face of your Dial be towards the North, you must turn the Dial the bottom upwards and reckon the Hours the contrary way; So a South East decliner will be a North East decliner, and a South West decliner, will be a North West decliner, leaving out the hour-lines (which will be needless) before Sun-setting and after Sun-rising.

How by the height of the Stile, the Declination of the Sun, to find what time the Sun shall part, from one side of a Declining Plane to the other.

The Canon for Calculation,

As the Radius 90 degrees.   10.00000
Is to the Tang. of the Sun's De. 23 : 30, 9.63830
So is the Tang. of the Stiles hei. 34 : 21, 9.83469
To this Co-Sine, viz.   72 : 43, 19.47299
From which Subtract   30 : 47.
The Planes Longitude   ————
And there Remains,   41 : 56

Which 41 : 56 resolved into time (by allowing

alowing 15 deg. to one hour, and for every odd
deg. 4 min, maketh 2 hours 48 min. Afternoon
that the Sun forsaketh the South Dial Declining
East, to shine upon the North Dial declining West:
So by the same Calculation the Sun forsaketh the
North Declining East 2 Hours 48 min. before
Noon, to shine upon the South Declining West.

Again the Sun being in VS, the Southern Sines.

unto ————————————	72 : 43
Add the Planes Longitude ————	30 : 47
	102 : 90
The Sum is, ————————	103 : 30

Whose Complement to 180 deg. is, 76 : 30
Which converted into time is 5 Hours 6 min.
for the time in Capricorn, when the Sun passeth
from one side of the plane to the other, between
which two Limets the Annual variety of the Sun
is concluded.

CHAP. IX   Fig 7.

How to draw Hour-lines upon a South or
North Dial Declining either East or West
to any Declination, and in any Latitude,
by the SECTOR. And how to find, by it, the
Subfiles distance from the Meridian; the Stiles
height, and the Planes Longitude.

The

The Example shall be that in the last Chapter of the Plain **Declining** 25 degrees.

First, describe the Quadrant A B C, then supposing your Latitude to be 51 deg. 30 min. take it from your line of Chords, and set it from B to E in the Arch of the Quadrant, and draw the line E D parellel to B A, cutting the line A C in the point D, then take the distance D E, and setting one foot in the Center A, with the other describe the Arch G H O R.

Then take 25 degrees the Plains Declination from your line of Chords, and set from B to F in the arch B E C, and draw the line F A, cutting the arch G R in the point H, through which point draw the line S H N cutting the arch B E C in N, so shall the arch C N be 34 deg. 21 min. which is the height of the Stile above the Plain.

Then take the distance H S, and set it in the line D E, from D to K, through which point K draw the line A   Fig. 8. K L, cutting the arch B C in the point L, so shall the arch C L be the distance of the Subftile from the Meridian, 18 deg. 33 m.

Now from the point L, draw the line L T parellel to the line A C, cutting the arch G R in the point O, thro' which point O, draw the line A O I, cutting the arch B C in the point I, so shall the arch C I be 30 degrees 47 min. the Plains Longitude.

Lastly before the Dial can be drawn there is

another

Fig 8
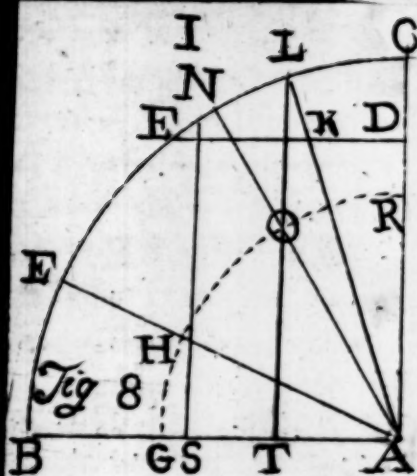
another thing that must be known, that is the
Angle of the Hour line of 12 and 6 o' the clock
and I shall shew that by Calculation as followes

The Cannon for Calculation.

As the Radius 90 Degrees   10. 0000
Is to the Sine of the Plains decli. 25 d. 9. 6259
So is the Tan. of the Latl. 51 : 30   10. 0993
To the Co-Tangent of 62 : 03,   10. 7259
Which is the Angle the 6 a Clock makes with
the Meridian, or 12 a Clock Hour line.

     To find the Four Requisites by the artificial
Sines and Tangents.

     1st. The Extent from the Sine of 51 deg.
30 min. the Latitude to the Sine of 90 deg. will
reach from the Tangent of 25 the Plains Decli-
nation, to the Tangent of the Plains Difference
of Longitude 30 deg. 47 min.

     2dly. The Exten from the Sine of 90 deg.
to the Sine of 59 deg. 13 min. the Complement
of 30 deg. 47 min. the Plains Difference of Lon-
gitude, will reach from the Tangent of 38 deg.
30 min. the Complement of the Latitude, to
the Tangent of 34 d. 21 m. the Stiles height.

     3dly. The Extent from the Radius to the
Sine of the Stiles height will reach from the Ta.
of 30 : 47 the Plains Difference of Longitude,
to the Tangent of 18 : 33, the Substiles distance
from the Meridian.

     4.

4thly. The Extent on the Sines from the Radius, to the Sine of the 25 d. the Plains Declination, will reach from the Tangent of the Latitude, to the Tangent of 27 : 56, whose Complement 62 : 03, is the Angle sought.

To draw the DIAL.

DRaw the line B M A L C, for the Horizontal line of the Plain, and Perpendicular thereunto, from the point A draw the line A H for the Meridian line, and with 60 Degrees of Chords draw the Prickt Arch Q C, then from Q towards the right hand because the Plain Declines West, set to R 62 : 3 min. the Angle of 12 and 6 o' the Clock, and draw the line R A, for the said Hour-line, then open your Sector (according to the bigness of your Plain) making A H, equal to the Sine of 65 deg. the Complement of the Declination, and A L, and A M the Sine of 38 d. 30 min. the Complement of the Latitude. And draw L G, and M E, parallel to A H. Then take the distance A H, and set from D, (the point where the hour-line of 6, cutteth the line L G,) to G, and draw the line G H E, then set the extent D G, on the line E M, upwards) from E, to X, and continue the line E M, to X. Make H G, or H E, a Radius on the greater Tangent; and lay from H towards E and G, the Tangent of 15 deg and 30 deg. for the Hours 10, 11, 1, 2. Also make D G, or X E, a Radius on the line of Tangent, and set from X,

and D, rowards E and G, 15 deg. 30 deg. for the Hours of 7, 8, in the Morning, and 4, 5, in Afternoon, And lines drawn from A to thele feveral Divifions, and alfo to the Angles E and G, and you have the Hour lines required. Thofe hour-points that fall above the Horizontal line, muft be drawn thro' the Center to fupply what is wanting on the other fide of the Meridian, as in this **Example.** 7 in the Morning drawn thro' the Center makes 7 in the Evening &c.

So you have below the horizontal line of the Plain, 8, 9, 10, 11, 12, 1, 2, 3, 4, 5, 6, and 7.

If you defire the Quarters, half hours, and three quarters this little Table will direct you by fetting off the Tangents upon every line you make Radius.

Note, 1. From Q to S (in the pricked Arch) fet 18 deg. 33 min. and draw the line A S, for the Subftile.

2. Set from S, to O, 34 deg. 21 min. and draw the line A O, for the Stile, which muft ftand perpendicular upon the line A S, and your Dial is finifhed.

D.	M.
03	45
07	30
11	15
15	00
18	45
22	30
26	15
30	00
33	45
37	30
41	15
45	00

3. In the Geometrical Conftruction of this Dial in the laft Chapter, the hour line of 8

at night falls above the horizontal line. it must
be drawn only thro' the Centre, for the hour line
of 8 in the morning ; which is a Case that will
happen in the Construction of Dials Calculated.

4. Set your Stile Perpendicular on the Substile
A S, making an Angle of 34 : 21, represented
in figure 7, by the Triangle S A O, and your
Dial is finished.

5. In the making of this you have made a
South Dial declining 25 deg. Eastward, as you
may see in page 31.

CHAP. X.   fig. 9.

How to Calculate and draw Hour-lines upon
a South or North Dial Declining East 81
deg. in the Latitude of 51 : 30 .

Accoding to the Method I shall here take,
the Stile may be so Proportioned , by the
Descretion of the Artist, as to fill the Plane
by Inspection with Convenient hour-lines.

Before the Dial can be drawn , observe the di-
rections of the viii Chapter, in finding the Sub-
stiles distance, the Stiles height , and the Planes
difference of Longitude, and makeing a Table
as there taught.

Thefe

Thse things being done, draw a Perpendicular
lne upon the Plane, as AB, and with 60 deg.
of Chords, setting one foot in **A**, describe the
Arch **CD**; then take in your Compasses (from
the Scale of Chords) 38 : 09, the Substile's
dstnce, and set it from **C** to **R**, and draw the
prickt line AR for the Substile; this done, Take
from the Scale of Chords, 05 : 53, the Stile's
height, and set it from the Substile, where it in-
tersects the Circle, as from R to S, and draw the
line A S for the Stile, then consider the bigness
of your Plane, so as you may Augment the Stile,
that the Hour-lines may fill the Plane, which in
this Dial I shall raise 9 Inches, (or 750 Parts of
a foot, the foot being divided into a 1000 equal
Parts,) as the line ET, parallel to the line SO,
so will the Stile be augmented; then make coice
of two Points in the Substile; as at F and G, and
draw the two Contngent lines, as M M and KK
at right Angles with the Substile; then measure
the height of your augmented Stile in equal parts
as from G to E, which I find to be 14 Inches
or 1165 equal parts, and from F to T 11 Inches,
or 915 equal parts, which two numbers are to be
made use of in the Calculation of the several hour
distances, by this Analogy. As the Radius 90
degrees, is to the Logarithm of the Stile's height
in Parts, (in either of the Contingent Lines,)
so the Tangent of the Angle at the Pole, to the
Logarithm in equal parts for that hour-distance

from

from the Subſtile, and ſo for the diſtance in Parts, in the other Contingent line for the ſame hour, as ſhall here be demonſtrated in the 6 a Clock Line, it being the firſt line on the upper ſide of the Subſtile, whoſe Angle at the Pole is (as you may ſee by the following Table) 07 deg. 04 min.

The Table.

The Latitude of the place	51 : 30
The Planes Declination	81 : 00
The Subſtiles diſtance	38 : 09
The Stiles Height	05 : 35
The Planes Longitude	82 : 56

Eaſt. Declinatio.	Equinoctial diſtances		Houi-diſtances in Parts	
iiii	37	04	691	881
v	22	04	380	475
vi	07	04	113	144
Subſtile	Subſtile		Subſtile	
vii	07	56	127	161
viii	22	56	387	493
ix	37	56	713	908
x	52	56	1211	1542
xi	67	56	2257	2874
xii	82	56	7381	9399

The

The Calculation in the Contingent KK.

As the Radius 90 degrees   10.00000
To the Logar. of the ftile's height 915, 2.96142
So the Tangent of 07 deg. 04 min.   9.09330
To the Logarithm of 113 · ·   12.05472

Which is the diftance in Parts of the Hour-line of 6 from the Subftile, on the Contingent KK

The Calculation in the Contingent MM.

As the Radius 90 degree   10.00000
To the Loga. of the ftile's height, 1165. 3.06632
So the Tangent of 07 deg. 04 min.   9.09330
To the Logarithm of 144 ·   2.15962

Which is the diftance in Parts of the Hour-line of 6 from the Subftile, on the Contin. MM.

By this Analogy may the reft of the Hours-Arches be found, which may eafily be projected into the Dial from the feveral Calculations, by taking the Hour-Arches in Parts, and placing them from the Subftile F and G, upon their proper Contingent Lines, through the Plane the Gnomon, (or ftile) fet directly over the Subftile, and the Work is finifhed.

CHAPTER,

CHAP. XL.   fig. 9

ow to draw Hour-lines upon a South or North
ial, **Declining East** 8 1 deg. by the Sector.

Aving found the Substiles distance, the
Stiles height, and the Planes Difference of
Longitude, make a Table as hath been
taught; and draw the Perpendicular line
B, and with 60 deg. of Chords, setting one foot
A, describe the Arch CD; then take in your Com
ses (from the Scale of Chords) 38 : 09, the Sub
e's distance, and set it from C to R, and draw the
kt line AR for the Substile; this done, Take from
Scale of Chords, 05 : 53, the Stile's height, and
it from the Substile, where it intersects the Cir-
as from R to S, and draw the line A S for the
e, then consider the bigness of your Plane, so as
u may Augment the Stile, as to bring on all the
ur-lines from 4 in the morning, to 11, or 12 ;
which purpose I draw the line ET, parallel to
line SO, so will the Stile be augmented ; then
ke choice of two Points in the Substile, as at F a d
and draw the two Contingent lines, as MM and
K, at right Angles with the Substile. Then take
distance GE, with your Compasses, which is the
ght of the Stile augmented and set one foot in 45
rees of your greater Tangent on your Sector, and
n the other Leg, till the Compasses falls on 45 deg
e Sector so opened, take out the Parallel distance
7 : 04, and set from G, on the Contingent line
upwards

Fig 9
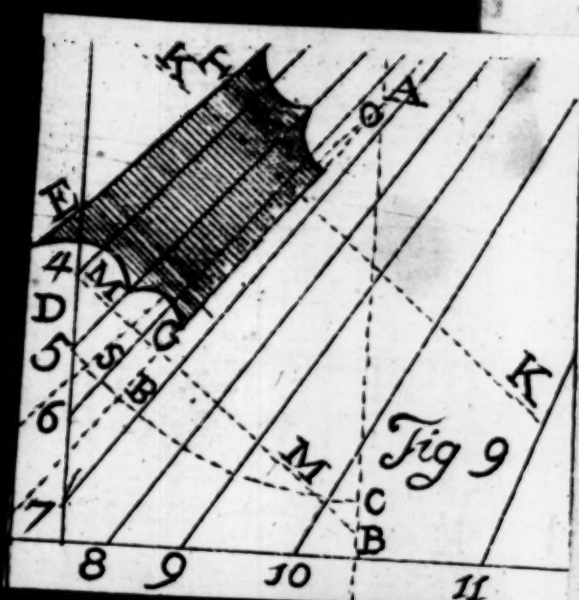
upwares for the hour-line of 6 in the morning; and
the Parallel distance of 22 deg. 04 min. set upward
from G for 5 a clock; and the Parallel distance of

East. Declinati.	Equino. distances.
iiii	37 04
v	22 04
vi	07 04
Substile	Substile.
vii	07 56
viii	22 56
ix	37 56
x	52 56
xi	67 56
xii	82 56

37 : 04, and set from G
on the Contingent line
upwards for the hour
line of 4. Having finish-
ed the hour-points on
the one sides of the Sub-
stile, take the Parall.
distance of 07 : 56. (as
the Sector stands) and
set dowdwards from G
on the Contingent-line
for the hour of 7. the
Parallel distance of 22:
56, for the hour of 8.
37 : 56, for the hour of
9. 52 : 56, for the hour of 10. 67 : 55, for the
hour of 11. and 82 : 59, for the hour of 12.

Then work after the same manner with the
Contingent line KK, making FT, (the height
of your Stile augmented equal to the Tangent
of 45 deg. and take off the several Tangents, as
you did before, placing them both wayes from
the Substile F, and thro' the Points in both Con-
tingent Lines draw the Hour-Lines setting the
Stile directly over the Substile, and your Dial is
finished.
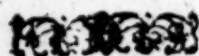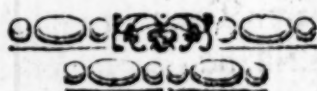
SECTION I.

Of Direct South Recliners.

IF the Plain on which you are to draw Hour-lines be a Direct South Recliner, Take the difference between the Plains Reclination and the Complement of your Habitation, and it will give you a new Latitude, where that Direct Reclining Plain will become an Horizontal Plain.

If the Recliaation be equal to the Complement of the Latitude, then the Pole hath no Elevation, and the Hour lines will be all Parallel to one another.
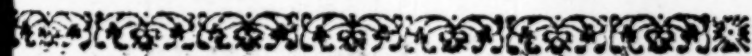
SECTION II.

Of Direct North Recliners.

IF the Plain be a Direct North Recliner, and that Riclination be equal to the Latitude of your Habitation, add it to the Complement of your Latitude, and that sum will be 90 deg. for the Latitudde under the Poles of the World; where you have no more to do, than to divide a Circle into 24 equal Parts, and lines drawn to the Center shall be the true Hour Lines, on such a North Reclining Plain : But Note, that this Dial is of no use in the North Latitude when when the Sun is in Southern Signs, nor in South
Latitude,

Latitude when he is in Northern Signs.

And whatever the Reclination of your Plain be, add it to the Complment of your Latitude, and that shall give you a new Latitude, where it will become an Horizontal Dial. But Note,

If the Reclination of the Plain, and the Complement of the Latitude exceed 90 deg. you must take the Complement thereof to 180 deg. and that is the New-Latitude where it will become an Horizontal Dial.
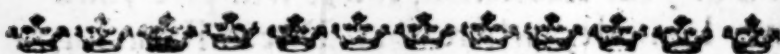
SECTION III.

A Correct Table of Latitude and Difference of Meridians from London, of some Eminent Places in the World.

Places in England.	Latitude		Diff. Meri.		
	D.	M.	H.	M.	
LONDON,	51	30	00	00	
Bristol,	51	28	00	11	W
Buckingham	51	58	00	04	E
Bath in Somersetshir	51	21	00	10	W
Guilford, in Surry,	51	13	00	02	W
Gloucester,	51	53	00	05	W
Dover in Kent	51	10	00	06	E
Colchester, in Essex	51	55	00	04	E
Canterbury, in Kent	51	18	00	05	E
Hereford,	52	04	00	11	W
Hartford,	51	47	00	00	
Salisbury, in Wiltshi	51	14	00	06	W
Rochester, in Kent,	51	25	00	02	E
Reading, Berkshire,	51	14	00	04	W

The Table Continu'd.

Places in England.	Latitued.		Diff. Meri.		
	D.	M.	H.	M.	
Oxford,	51	45	00	05	W
Wells, in Somersetshi	51	11	00	11	W
Woodstock,	51	53	00	05	W
Winchester,	51	03	00	05	W
Places in Wales					
Cardiff, in Glamorga.	51	31	00	13	W
Carmarthen,	51	53	00	17	W
Landaff,	51	33	00	01	W
Monmouth,	51	50	00	11	W
Pembroke,	51	42	00	20	W
Antwerp, in Flanders	51	20	00	16	E
Wittenburg, in Garm	51	54	01	00	E
Wymour, in Garmany	51	04	00	51	E
Ostend, in Flanders	51	11	00	12	E
Dunkirk, in Flanders	51	01	00	09	E
Ghent, in Flanders	51	01	00	15	E
Goes, in Zealand	51	30	00	16	E
Leipfick,	51	19	00	53	E
Rotterdam,	51	55	00	17	E
Caffels,	51	19	00	36	E
Cork,	51	45	00	30	W

Note, At all the Places Named in the foregoing Table of Latitude; the Table shewing the Hours, and Quarters of an Hour from the Meridian, in all **Declining Dials**, will serve as well as at **London**, and likewise at many other Places not here mentioned, which are within 60 Minutes of Latitude either greate, or lesser.

I a

In the following Table of Latitude are the
names of Places, having greater Latitude, and are
useful to those that Calculate Dials for other La-
titudes ; and the Difference of Meridian, are of
use to Infert the Meridians of other Contries up-
ro Sun Dials. How to use them, I fhall give an
Account after the Table.

SECTION IV.

A Correct Table of Latitude and Difference
of Meridians from London, of some Eminent
Places in the World.

Places in Names.	Latitude D. M.		Diff. Meri H. M.	
Madrid in Spain.	40	10	00	13 W
Lisbon in Portu-	38	50	00	51 E
Lions in France.	48	15	00	20 E
Mexico.	20	06	06	49 W
Port Royal in Jamaica.	17	40	05	04 W
Jerufalem.	31	22	02	28 E
Edinbourough in Scotlan	55	57	00	12 W
Leghorn.	43	18	00	51 E
Frankford.	50	04	00	33 E
Babylon in Chaldea.	34	30	03	14 E
Boſton in New-England	42	25	04	52 W
Barbadoes.	13	30	03	53 W
Rome.	41	51	00	52 E
Tangier	35	55	00	25 W
Stockholm	58	50	01	10 E
Venice	45	18	00	50 E

SECTION V.

Of the Meridians of other Countries and how to Insert them into Sun Dials.

IT is easie to Insert the Meridians of any other Contry into any Sun Dial, made for any Place; if first you know the **Difference** of Longitude between the two Countries in Time, and also whether the Remote Country lie Eastward or Westward from the Home Country: For if the Remote Country lie Eastward of the Home Country, it is Noon sooner than it is at the Place the Dial doth stand in; if it lie Westward, then later.

As for **Example.**

Suppose that in a Sun Dial at **London**, you would Insert the Meridian or Noon-tide of Barbadoes, which by the best Geographers lies Westward of London 58 degrees 15 min. which converted into Time, by allowing for every hour 15 Degrees, and for every odd degree 4 min. it makes 3 Hours 53 min. Wherefore if you add 3 hours 53 min. to 12 a clock at London, it makes 3 hours 53 min. past Noon. Therefore if upon a Sun Dial at London, you write, the word **Barbadous**, upon 52 min. past 3, (or make this * ,) the shadow of the Stile of the Dial, when it shall fall upon the mark you may conclude it to be Noon at Barbadous; and

knowing

knowing that, it is eafiely known what hour it is at any time of the Day; For if you lay a Rule from the Center of your Dial to 52 min. paft 04 at London it gives you the point for one of the Clock in the Afternoon, and to 52 min. paft 5 in the afternoon at London it gives you the Hour-point of 2 a Clock in the afternoon at Barbadoes, and fo proceed round the Dial to lay the Rule to 52 min. paft every Hour &c. and the fame Shadow that fhews the Hour at London, in its Paffage over the other hour-points gives the true Time at Barbadoes.

Note. The beft fort of Dials to Infert the Difference of Meridians upon, are the Polar Dial, and the Horizontal, becaufe the Sun fhineth on thofe Plains, from his Rifing to his Setting.

And if you Infert the Meridian of Barbadoes on either of thofe Dials, the Mid-night Meridian will fall on 52 min. paft 4 in the Morning, and it is be the beft way to make the hour line and figure of another Couler, or Sort, that you may know it from the Noon Meridian.

You may by thefe Tables (or any other that hath the Difference of Meridians in Time) find the hour at any Place affign'd, without having it Inferhed upon a Dial, by fubftracting the difference of meridians from the Time at London, if the Place be Weft from London, or adding, if it be Eaft, and by having the Time of any Eclipfe, or New or Full Moon, &c. at London, may know the hour and min. it is at any other place mentioned in the Tables

SECTION VI.

A
New Way
OF
DIALLING,

Performed by the SECTOR.

How to draw Hour-lines upon an Horizontal
Dial with twice opening the Compaſſes. (Fig. A)

FIRST draw the line DAE, for the
hour line of 6. And perpendicular there-
unto the line A O B, for the hour line
of 12 ; take any convenient diſtance as A B,
and make it a parellel Sine of 90 deg. on your
Sector. Then lay the Sine of the Latitude 51 d.
30 min. from A to D and E, and draw the line
B D, and B E, a d divide them into two equal
parts as at O. Then make O B, or O D a Pa-
rallel Radius, that is take the given line in your
Compaſſes ſetting one foot in 45 deg. of the
greater Tangent, and open the Sector til the
other Foot falls on 45, then take the Tangent
of 15 deg. 30 deg. nnd lay from O towards B
and

and D, and from O towards B and E, and you
have the hour points of 7, 8, 9, 10, 11, in the
morning, and 1, 2, 3, 4, and 5 in the afternoon,
the points O, being the Hour points of 9 in the
Morning, and 3 in the Afternoon. Laftly, from
A, the Center thro' thefe points draw lines, and
they will be the hour lines. The Stile meets the
Plain in A, and ftanding over the Meridian A
12, makes an Angle with it of 51 deg. 30 min.
The Hours 4, 5, before 6 in the morning and
7 and 8 after 6 in the evening, are drawn by
continuing their oppofite hour lines 4, 5, in the
afternoon, and 7, 8, in the forenoon, beyond
the Center. In like manner may a Direct South
or North Dial be drawn, omitting thofe hour-
lines that would be ufelefs, and inftead of the
Latitude, fet the Complement (38 : 30) from
A, to E, and D, in figure B.
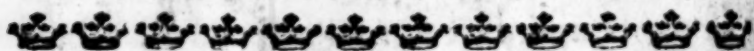
S E C T I O N VII.

Of Declining Dials.

LET the Example be for a South Dial, De-
clining 25 deg. Weftward, in the Latitude
of 51 deg. 30 min.

IN order to this, there are four Things ne-
ceffary, which may very readily be obtained by
the Sector, in the following manner.

1ft.

First, for the Substiles distance from the Meridian.

Take with your Compasses the distance from the Center of your line of Sines, to the fine of the Plains Declination 25 deg. (which is called in Sectoral Terms the Crural distance)then 'et one foot in 90 deg. of fines, open the other Leg untill the other foot falls on the fine of 90 deg. (which is called the Parallel distance,)then take the Parallel distance of 38 deg. 30 min. the Complement of the Latitude, and meature it on the Tangent line from the Center, it giv's 8 deg. 33 min. for the Substiles distance from the Meridian.

Secondly, for the Stiles Height.

Take the Crural distance of the Sine of the Complement of the Plains Declination 65 deg. and make it a Parellel distance in the Sine of 90 deg. then the Parellel distance of 38 deg. 30 m the Complement of the Latitude, meatured from the center of the line of Sines, gives 34 deg. 21 min. for the Stiles Height.

Thirdly, for the Plains Longitude.

Make the Extent from the Center of your Tangent to the Tangent of the Complement of the Plains declinatitns 65 deg. a Parellel distance in the Sine 90 deg. then take the Parallel distance of 51 deg 30 min. the Latitude of the Place, and meature from the Center of the Tangent gives 59 deg. 23 min. whose Complement 30 deg. 47 min. is the Plains Longitude.

Fourthly

Fourthly, for the Angle of 12 and 6.

Make the Extent from the Center of your line of Sines to 25 deg. the fine of the Plains Declination, a Parallel distance in the fine of 90 deg. then the Parallel extent of the Latitude of the place 51 deg. 30 min measured from the Center of your Tangent. gives 28 deg. whose Complement 72 deg. is the Angle of 12 and 6.

Note, The Angle of 12 and 6 in Decliners in this Latitude, may be found in the Tables of Declining Dials.

Figure VII.

Aving draw M B A L for the Horizontal line of the Plain, then draw from (A the Center of the Dial) the line A H perpendicular thereunto for the Hour line of 12. Then with 60 deg. of Chords describe the Circle B Q C, and lay from Q to R the (62 deg.) the Angle of 12 and 6 and from R thro' A the the Center draw the hour line of 6 continuing it to X, above the Horizontal line of the Plain. Then open your Sector according to the bigness of the Plain, and make A H equal to the Sine of 65 degrees the Complement of the Plains Declination. the Sector remaining thus opened, take the Parallel distance of 38 deg. 30 min the Complement of the Latitude, and let from A to L and draw the line L D G Parallel to A H the Meridian.

Then from the Point where the hour line of 6 cuteth the line L D G, as D, draw the line

D

D H. Make A X, equal to A D, and draw the
line H X, which two lines divide into two e-
qual parts as at O O; then make O H, or O X
Radius, or equal to the Tangent of 45 deg. of
the Sector, and take the Parallel Tangent of
15 deg. 30 dg. and lay from O towards X and
H, for the hour points of 7, 8, (O being the
hour-point for 9)10, 11, in the Morning.

Then make O H, or O D, Radius. and lay
the Parallel Tangent of 15 deg. 30 deg. from
O, towards H, and D, for the hour points of 1
2, (O, being 3)4, 5, in the afternoon. Those
hour points in the line H O X, that fall above
the Horizontal line. muſt be drawn thro' the
Center to ſupply what is wanting on the other
ſide of the Meridian, as in this **Example**, 7 in
the Morning drawn thro' the Center makes 7
in the Evening &c. Lines drawn from the Cen-
ter A, and thro' thoſe hour points, you will have
below the horizontal line of the Plain, 8, 9, 10,
11, 12, 1, 2, 3, 4, 5, 6, and 7.

	D.	M.
If you deſire the Quarters, half hours, and three quarters this little Table will direct you by ſetting off the Tangents upon every line you make Radius.	03	45
	07	30
	11	15
	15	00
	18	45
Laſtly, from Q to S (in the pricked Arch) ſet 18 de. 33 min. and draw the line A S, for the Subſtile, and from S, to O, ſet 34 d. 21 min. and draw the line A O, for the Stile, which muſt ſtand per- pendicular upon the line A S, and your Dial is finiſhed.	22	30
	26	15
	30	00
	33	45
	37	30
	41	15
	45	00

SECTION VII.

How to make an Horizontal Dial, on the botto
of a Box, to shew the hour of the Day, wi
out a Stile.

THE Box may be square or Round, whic
you like best, and of any convenient bigne
as 6 or 7 Inches, and the depth an Inch and ha
or 2 Inches, with a ledge within to lay a piece
of Glass upon, as those Boxes have that are tur
ed for Magnetical Needles.

Make an horizontal Dial on Paper the exa
bigness of the bottom of the Box and paste it ther
on; then consider if there was a Stile on this Di
it would pass through the Glass, and the ve
point were the Stile would go through, is th
point were you may make a Lyons paw, or wha
you best fancy. To find this point do thus: C
a pattern of the Stile of your Dial in Paste-board
making an Angle equal to the Latitude of th
place your Dial is made for, and fix it on the
rid an with gum water, and let it be long enoug
to reach beyond the ledge the Glass lieth upon.
Then clip off the Stile, till it will just touch th
Glass when it is laid on the ledge, then mar
with a Pen and Ink the point which toucheth th
Glass, and that is the point required.

When you have drawn on the Glass, wha
Fancy you will, to represent the point of the Sti
you may put a Wire, or wax round the edge
the Glass, to keep it from wet and wether.

The End of the First Part.

TABLES,

Fig 6

I
E
5
6
7
8
B
A
G
10   11

Fig 7
M B
A   C L
Fig 7
R D
o
Q   S
E
II
ll 12 1 2 a 3
6
7
6
5
4
3

Fig 1
h Q
Fig 1
Q
h
S
Q T   O   V R
C   D

Fig 2
A   B
E Z
Fig 3
Æ
D
M   L
H A   T   O   G
B S
Q
B
shame
m e
Fig 4
C   A
ri
dow
D

Fig A
10 11 12 1 2
9
I   B   G 3
8
O
H
D   Fig A   F
6   C   E
5   5
6
7
8

Fig B
D   A   E 6
6
7
5
8
I   Fig B   G 3
9
10 11 12 1 2
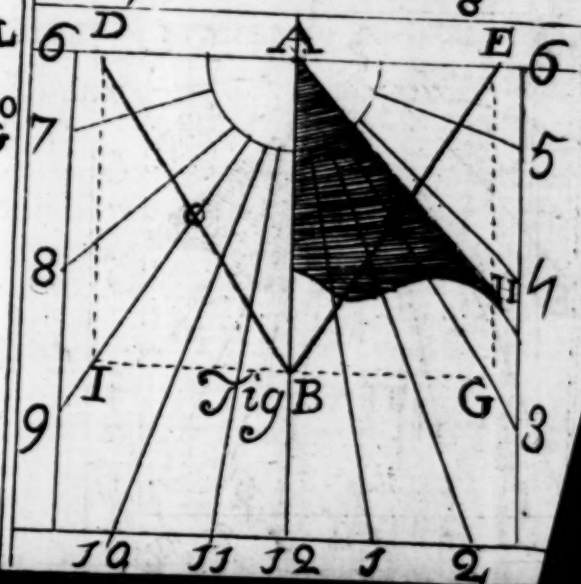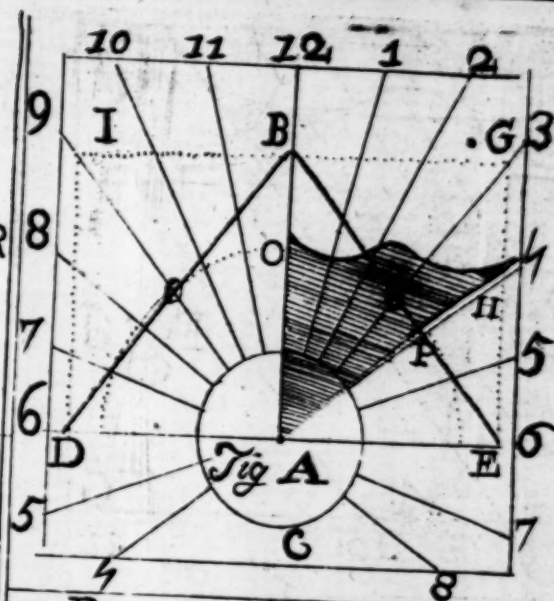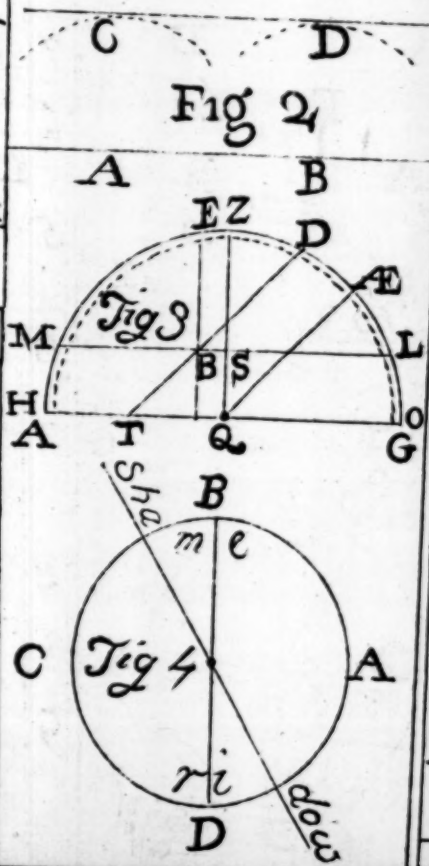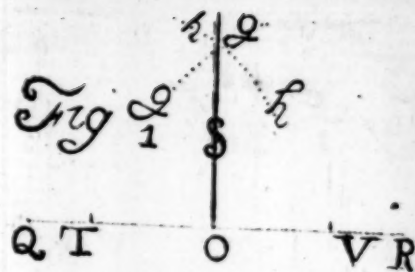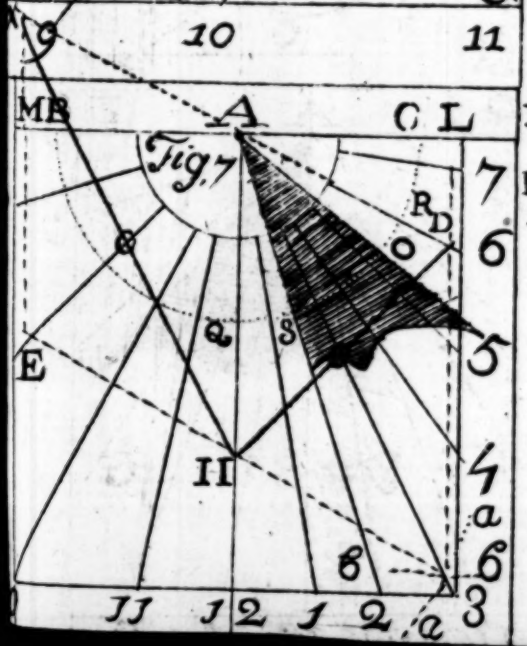
TABLES

Calculated for the

atitude of 51 deg. 30 min.

Viz. LONDON,

Containing

e Hour Diſtances, and Parts of an Hour from
he 𝕸𝖊𝖗𝖎𝖉𝖎𝖆𝖓, in all 𝕯𝖊𝖈𝖑𝖎𝖓𝖎𝖓𝖌 𝕯𝖎𝖆𝖑𝖘, from
t *Deg.* of Declination to 60 *Deg.*

WITH

rections Teaching any Perſon tho' unlearned in
he Mathematicks, to draw a true SUN-DIAL,
pon any given P L A N, however Situated in
eſpect of Declination.

By John Good.

A TABLE of Hour Distances, and Parts of an Hour from the Meridian, in Declining Dials, in the Latitude 51 degrees, 30 minutes from 1 deg. of Declination to 60.

South Declin.		00	01	South Declin.		02	00
Subſt. Diſtanc.		00	48	Subſt. Diſtanc.		01	36
Stiles Height		38	29	Stiles Height		38	28

Hours.		d.	m.	Hours.		d.	m.
vi		00	00	vi		00	00
I	3	85	14	I	3	84	52
2	2	79	16	2	2	78	48
3	1	73	26	3	1	74	35
vii	v	67	47	vii	v	68	51
I	3	62	23	I	3	63	22
2	2	57	14	2	2	58	08
3	1	52	23	3	1	53	11
viii	iiii	47	50	viii	iiii	48	32
I	3	43	34	I	3	44	10
2	2	38	53	2	2	40	04
3	1	35	59	3	1	36	14
ix	iii	32	15	ix	iii	32	37
I	3	28	04	I	3	29	13
2	2	24	56	2	2	26	00
3	1	22	00	3	1	22	57
x	ii	19	55	x	ii	20	03
I	3	17	11	I	3	17	06
3	2	14	32	2	2	14	37
2	1	11	59	3	1	12	02
xi	i	09	30	xi	i	09	02
I	3	07	04	I	3	07	06
2	2	04	41	2	2	04	42

Declining 01 Deg.				Declining 02 Deg.			
3	I	02	21	3	I	02	19
xii		00	00	xii		00	00
I	3	02	40	I	3	02	31
2	2	04	41	2	2	04	41
3	I	07	02	3	I	07	02
i	xi	09	26	i	xi	09	2
I	3	11	52	I	3	11	15
2	2	14	18	2	2	14	19
3	I	16	58	3	I	16	15
ii	x	19	38	ii	x	19	2
I	3	22	24	I	3	22	1
2	2	25	18	2	2	25	0
3	I	28	59	3	I	28	37
iii	xi	31	33	iii	ix	31	51
I	3	34	54	I	3	34	36
2	2	38	33	2	2	38	08
3	I	42	34	3	I	41	1
iiii	viii	46	29	iiii	viii	45	5
I	3	50	55	I	3	50	14
2	2	55	52	2	2	54	41
3	I	60	46	3	I	59	3
v	vii	65	33	v	vii	64	4
I	3	71	09	I	3	70	0
2	2	76	52	2	2	75	4
3	I	82	44	3	I	81	33
vi		88	44	vii		87	3

South Declining 03 00	*South Declining* 04 05
Substiles Dista. 02 23	*Substiles Dista.* 03 11
Stiles Height 38 26	*Stiles Height* 38 2

Declining 03 Deg.			Declining 04 Deg.		
Hours.	d	m	Hours.	d	m
vi		co	oo	vi		oo	co
I	3	87	43	I	3	89	01
2	2	81	42	2	2	83	00
3	1	76	46	3	1	77	00
vii	v	69	58	vii	v	71	08
I	3	64	24	I	3	65	29
2	2	59	05	2	2	60	04
3	1	54	01	3	1	54	55
viii	iiii	49	55	viii	iiii	50	03
I	3	44	48	I	3	45	29
2	2	40	27	2	2	41	13
3	1	36	41	3	1	37	12
ix	iii	33	02	ix	iii	33	26
I	3	29	33	I	3	30	15
2	2	25	16	2	2	26	33
3	1	23	19	3	1	23	24
x	ii	20	13	x	ii	20	24
I	3	17	25	I	3	17	34
2	2	14	42	2	2	14	49
3	1	12	06	3	1	12	10
xi	i	09	34	xi	i	09	38
I	3	07	07	I	3	07	09
2	2	05	42	2	2	04	44
3	1	02	20	3	1	02	41
xii		00	00	xii		co	00
I	3	02	20	I	3	02	20
2	2	04	41	2	2	04	40
3	1	07	01	3	1	07	00
i	xi	09	23	i	xi	09	22

Declining 03 Deg.				Declining 04 Deg.		
I	3	15	48	I	3	11	4
2	2	14	15	2	2	13	54
3	1	16	24	3	1	16	41
iiii	x	19	23	ii	x	19	1
1	3	22	04	1	3	21	5
2	2	24	53	2	2	23	56
3	1	27	50	3	1	26	47
iii	ix	30	55	iii	ix	30	37
1	3	34	11	1	3	33	4
2	2	37	39	2	2	37	1
3	1	41	19	3	1	40	
iiii	viii	45	18	iiii	viii	44	3
1	3	49	25	1	3	48	4
2	3	53	52	2	2	51	5
3	1	58	37	3	1	56	
v	vii	63	39	v	vii	62	3
1	2	69	01	1	3	67	
2	2	74	32	2	2	73	
3	1	80	19	3	1	79	
	vi	88	16		vi	84	

South Declining 05 00	South Declining 06
Substiles Dista. 03 58	Substiles Dist. 04
Stiles Height 38 20	Stiles Height 38

Hours.		d.	m.	Hour.		d.	
2	2	84	15	2	2	85	
3	1	78	13	3	1	79	
vii	v	72	19	vii	v	73	
1	3	66	35	1	3	67	
2	2	61	03	2	2	62	

Declining 05 Deg				Declining 06 Deg.			
3	i	55	49	3	i	56	43
viii	iiii	50	51	viii	iiii	51	49
i	3	46	12	i	3	46	54
2	2	41	46	2	2	42	25
3	i	37	42	3	i	38	04
ix	iii	33	52	ix	iii	34	18
i	3	30	15	i	3	30	50
2	2	25	51	2	2	27	09
3	i	23	38	3	i	23	53
x	ii	20	35	x	ii	20	37
i	3	17	41	i	3	17	50
2	2	14	55	2	2	15	02
3	i	12	15	3	i	12	20
xi	i	09	38	xi	i	09	35
i	3	07	41	i	3	07	13
2	2	04	51	2	2	40	46
3	i	02	25	3	i	02	22
xii		00	00	xii		co	co
i	3	02	20	i	3	02	20
2	2	04	51	2	2	04	39
3	i	06	59	3	i	06	59
i	xi	09	21	i	xi	09	19
i	3	11	43	i	3	11	41
2	2	14	08	2	2	14	05
3	i	16	36	3	i	16	31
ii	x	19	08	ii	x	19	02
i	3	21	51	i	3	21	37
2	2	24	30	2	2	24	19
3	i	27	20	3	i	27	07
iii	ix	30	19	iii	ix	30	02
i	3	33	28	i	3	33	07

Declining 05 Deg.				Declining 06 Deg.			
2	2	36	47	2	2	36	22
3	1	40	18	3	1	39	49
iiii	viii	43	03	iiii	viii	43	37
1	3	48	03	1	3	47	24
2	2	52	19	2	2	51	34
3	1	56	52	3	1	56	01
v	vii	61	42	v	vii	61	46
1	3	66	50	1	3	65	48
2	2	72	14	2	2	71	08
3	1	77	55	3	1	76	43
vi		83	44	vi		82	34
1	3	89	43	1	3	88	28

South Declin. 07 00	South Declin. 06 00
Subst. distance 05 32	Subst. distance 06 19
Stiles Height 38 10	Stiles Height 38 04

Hours.		d.	m.	Hours.		d.	m.
2	2	86	46	2	2	88	07
3	1	80	42	3	1	81	58
vii	v	74	41	vii	v	75	54
1	3	69	49	1	3	71	35
2	2	63	06	2	2	64	13
3	1	57	40	3	1	58	39
viii	iiii	53	30	viii	iiii	53	23
1	3	47	38	1	3	48	06
2	2	43	03	2	2	43	45
3	1	38	46	3	1	39	21
ix	iii	33	45	ix	iii	35	15
1	3	30	58	1	3	32	25

Declining 07 Deg.				Declining 08 Deg.			
2	2	27	26	2	2	27	48
3	1	24	07	3	1	22	28
xi	ii	21	58	x	ii	21	11
1	3	18	00	1	3	18	30
2	2	15	08	2	2	15	17
3	1	12	25	3	1	12	30
xi	i	09	47	xi	i	09	15
1	3	07	15	1	3	07	57
2	2	04	48	2	2	40	48
3	1	02	22	3	1	02	23
xii		00	00	xii		00	00
1	3	02	50	1	3	02	20
2	2	04	39	2	2	04	39
3	1	07	01	3	1	07	18
i	xi	08	58	i	xi	09	18
1	3	11	38	1	3	11	38
2	2	14	02	2	2	13	59
3	1	16	27	3	1	16	23
ii	x	18	56	ii	x	18	52
1	3	21	00	1	3	22	22
2	2	24	08	2	2	23	59
3	1	27	54	3	1	26	41
iii	ix	29	51	iii	ix	29	32
1	3	32	48	1	3	32	30
2	2	36	00	2	2	35	38
3	1	39	22	3	1	38	56
iiii	viii	42	58	iiii	viii	42	27
1	3	46	48	1	3	46	11
2	2	50	52	2	2	50	11
3	1	54	53	3	1	54	27

Declining 07 Deg				Declining 08 Deg			
v	vii	59	52	v	vii	58	59
1	3	64	48	1	3	63	05
2	2	70	02	2	2	63	38
3	1	75	34	3	1	74	24
	vi	81	17		vi	80	05
1	3	87	12	1	3	85	57

South Declin. 09 00	South Declin. 10 00
Subst. distance 07 05	Subst. distance 07 51
Stiles Height 37 57	Stiles Height 37 49

Hours.		d	m	Hours.		d.	m
2	2	89	11	3	1	84	30
3	1	83	18	vii	v	78	23
vii	v	77	10	1	3	72	30
1	3	71	09	2	2	66	24
2	2	65	18	3	1	60	49
3	1	59	40	viii	iiii	55	11
viii	iiii	54	18	1	3	50	01
1	3	49	13	2	2	45	08
2	2	44	26	3	1	40	33
3	1	39	57	ix	iii	36	15
ix	iii	35	45	1	3	32	14
1	3	30	47	2	2	28	28
2	2	28	09	3	1	24	57
3	1	24	41	x	ii	21	36
x	ii	21	19	1	3	18	30
1	3	18	20	2	2	15	33
2	2	15	24	3	1	12	43
3	1	12	36	xi	i	09	23

Declining 09 Deg.				Declining 10 Deg.			
xi	i	10	05	I	3	07	22
I	3	07	21	2	2	04	51
2	2	04	01	3	I	02	24
3	I	02	20	xii		00	00
	xii	00	00	I	3	02	21
I	3	02	16	2	2	04	40
2	2	04	39	3	I	06	58
3	I	06	08	i	xi	09	17
i	xi	09	16	I	3	11	35
I	3	11	35	2	2	13	54
2	2	13	56	3	I	16	16
3	I	16	18	ii	x	18	30
ii	x	18	45	I	3	21	05
I	3	21	14	2	2	23	41
2	2	23	49	3	I	26	19
3	I	26	29	iii	ix	29	04
iii	ix	31	24	I	3	31	55
I	3	34	21	2	2	34	35
2	2	37	33	3	I	38	06
3	I	40	55	iiii	viii	41	28
iiii	viii	44	31	I	3	45	02
I	3	48	21	2	2	48	52
2	2	52	25	3	I	52	56
3	I	56	26	v	vii	57	18
v	vii	61	25	I	3	61	56
I	3	66	21	2	2	66	45
2	2	71	35	3	I	72	09
3	I	77	07	vi		77	31
vi		82	50	I	3	83	28
I	3	88	45	2	2	89	25

South Declin. 11 00			South Declin. 12 00		
Subst. distance 08 38			Subst. distance 09 23		
Stiles Height 37 40			Stiles Height 37 30		

Hours.		d	m	Hours.		d.	m.
3	i	85	47	3	i	87	02
vii	v	79	39	vii	v	80	57
1	3	73	32	1	3	74	38
2	2	67	33	2	2	68	40
3	1	61	44	3	1	62	47
viii	iiii	56	10	viii	iiii	57	06
1	3	50	52	1	3	51	42
2	2	45	52	2	2	45	56
3	1	41	11	3	1	41	49
ix	iii	36	47	ix	iii	36	19
1	3	32	31	1	3	32	07
2	2	29	21	2	2	29	13
3	1	25	15	3	1	25	33
x	ii	21	52	x	ii	22	05
1	3	18	40	1	3	18	51
2	2	15	40	2	2	15	48
3	1	12	47	3	1	12	41
xi	i	10	02	xi	i	10	03
1	3	07	25	1	3	06	45
2	2	04	52	2	2	04	53
3	1	02	25	3	1	02	24
xii		00	00	xii		00	00
1	3	02	21	1	3	02	23
2	2	04	47	2	2	04	43
3	1	06	59	3	1	07	00

Declining 11 Deg.				Declining 12 Deg.			
i	xi	09	06	i	xi	09	07
1	3	11	35	1	3	11	35
2	2	13	53	2	2	13	53
3	1	16	13	3	1	16	11
ii	x	18	37	ii	x	19	32
1	3	21	19	1	3	20	57
2	2	23	33	2	2	23	36
3	1	26	08	3	1	25	59
iii	ix	28	55	iii	ix	28	27
1	3	31	39	1	3	31	23
2	2	34	36	2	2	34	18
3	1	37	43	3	1	37	20
iiii	viii	42	01	iiii	viii	40	34
1	3	45	20	1	3	44	03
2	2	48	14	2	2	47	38
3	1	52	11	3	1	51	32
v	vii	56	29	v	vii	55	43
1	3	61	15	1	3	60	12
2	2	65	54	2	2	64	52
3	1	70	54	3	1	72	00
vi		76	30	vi		75	23
1	3	82	13	1	3	81	02
2	2	87	45	2	2	86	55

South Declin. 13 00 Subst. distance 10 08 Stiles Height 37 21			South Declin. 14 00 Subst. distance 10 54 Stiles Height 37 10		
Hours.		*d.* *m.*	*Hours.*		*d.* *m.*
3	1	86 35	vii	v	83 31
vii	v	80 35	1	3	77 19
1	3	76 03	2	2	71 07
2	2	69 56	3	1	65 04
3	1	63 57	viii	iiii	59 12
viii	iiii	58 00	1	3	53 35
1	3	52 40	2	2	48 16
2	2	47 27	3	1	43 15
3	1	42 34	ix	iii	38 33
ix	iii	37 56	1	3	34 08
1	3	33 40	2	2	30 04
2	2	29 40	3	1	26 14
3	1	25 54	x	ii	22 39
x	ii	22 24	1	3	19 17
1	3	19 05	2	2	16 07
2	2	15 58	3	1	13 08
3	1	13 01	xi	i	10 17
xi	i	10 13	1	3	07 57
1	3	07 30	2	2	04 27
2	2	04 56	3	1	02 26
3	1	02 29	xii		00 00
xii		00 00	1	3	02 23
1	3	02 21	2	2	04 43
2	2	04 41	3	1	07 00
3	1	05 59	i	xi	09 18

Declining 13 Deg.				Declining 14 Deg.			
i	xi	09	15	I	3	11	33
1	3	11	32	2	2	13	49
2	2	13	49	3	1	16	06
3	1	16	80	ii	x	18	25
ii	x	18	28	1	3	20	41
1	3	20	50	2	2	23	12
2	2	23	53	2	3	25	41
3	1	25	48	iii	ix	28	14
iii	ix	28	24	1	3	30	12
1	3	31	80	2	2	32	55
2	2	33	58	3	1	35	50
3	1	36	57	iiii	viii	39	44
iiii	viii	40	08	1	3	43	00
1	3	43	28	2	2	46	29
2	2	47	02	3	1	50	13
3	1	50	51	v	vii	54	02
v	vii	54	51	1	3	58	28
1	3	59	17	2	2	63	01
2	2	63	57	3	1	67	54
3	1	68	55	vi		72	05
vi		74	12	1	3	78	36
1	3	80	47	2	2	84	22
2	2	83	12	3	1	88	40

South Declin. 15 00				South Declin. 16 00			
Subst. distance 11 38				Subst distance 12 22			
Stiles Height 36 58				Stiles Height 36 43			

Hours.		d.	m.	Hours.		d.	m.
vii	v	84	50	vii	v	86	09
1	3	79	38	1	3	79	55
2	2	72	24	2	2	73	39
3	1	66	16	3	1	67	27
viii	iiii	60	18	viii	iiii	61	24
1	3	54	34	1	3	55	33
2	2	49	08	2	2	49	59
3	1	44	00	3	1	44	45
ix	iii	39	12	ix	iii	39	49
1	3	34	44	1	3	35	14
2	2	30	29	2	2	30	56
3	1	26	36	3	1	26	57
x	ii	22	57	x	ii	23	13
1	3	19	29	1	3	19	43
2	2	16	18	2	2	16	07
3	1	13	15	3	1	13	21
xi	i	10	22	xi	i	10	26
1	3	07	37	1	3	07	39
2	2	04	59	2	2	05	00
3	1	02	38	3	1	02	27
xii		00	00	xii		00	00
1	3	02	24	1	3	02	25
2	2	04	44	2	2	04	45
3	1	07	01	3	1	07	08
xi	i	09	17	xi	i	09	18

Declining 15 Deg				Declining 16 Deg.			
1	3	11	32	3	3	11	34
2	2	13	48	2	2	13	44
3	1	16	04	1	1	16	02
iii	x	18	21	iii	x	18	19
1	3	20	42	1	1	20	37
2	2	23	05	2	2	22	58
3	1	26	23	3	3	25	22
iii	ix	28	03	iii	ix	27	52
1	3	31	40	1	3	30	27
2	2	33	15	2	2	33	09
3	1	35	14	3	1	35	56
iiii	viii	39	19	iiii	viii	38	55
1	3	42	44	1	3	42	03
2	2	45	56	2	2	45	23
3	1	49	34	3	1	48	56
V	vii	53	19	v	vii	51	54
1	3	57	36	1	3	56	48
2	2	62	06	2	2	61	10
3	1	66	52	3	1	65	52
	vi	71	59		vi	70	52
1	3	77	34	1	3	76	12
2	2	83	06	2	2	81	50
3	3	89	02	3	3	87	45

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| South Declin. 17 00 | | | South Declin. 18 00 | | |
| Subst. distance 13 05 | | | Subst. distance 13 49 | | |
Stiles Height 36 32			Stiles Height 36 18		
Hours.		d	m	*Hours.*		d	m
vii	v	87	28	vii	v	88	49
1	3	81	15	1	3	82	44
2	2	78	57	2	2	76	16
3	1	68	32	3	1	69	57
viii	iiii	62	32	viii	iiii	63	4
1	3	56	37	1	3	57	4
2	2	50	57	2	2	51	54
3	1	45	55	3	1	46	25
ix	iii	40	52	ix	iii	41	15
1	3	35	51	1	3	36	27
2	2	31	28	2	2	31	57
3	1	27	19	3	1	27	47
x	ii	23	34	x	ii	23	54
1	3	19	24	1	3	20	15
2	2	16	40	2	2	16	55
3	1	13	32	3	1	13	40
xi	i	10	31	xi	i	10	39
1	3	07	45	1	3	07	49
2	2	04	40	2	2	05	05
3	1	02	29	3	1	02	29
	xii	00	00		xii	00	00
1	3	02	24	1	3	02	25
2	2	04	44	2	2	04	47
3	1	07	00	3	1	07	0
i	xi	09	28	i	xi	09	20

Declining 17 Deg.				Declining 18 Deg.			
1	3	11	32	3	3	11	34
2	2	13	58	2	2	13	47
3	1	16	01	1	1	16	01
ii	x	18	16	ii	x	18	41
1	3	20	32	1	1	20	01
2	2	22	52	2	2	22	48
3	1	25	32	3	3	25	09
iii	ix	27	48	iii	ix	27	34
1	3	30	13	1	3	30	02
2	2	32	52	2	2	32	40
3	1	35	59	3	1	35	22
iiii	viii	38	32	iiii	viii	38	12
1	3	41	38	1	3	41	12
2	2	44	54	2	2	44	24
3	1	48	59	3	1	47	48
v	vii	52	04	v	vii	51	25
1	3	56	04	1	3	55	18
2	2	60	58	2	2	58	29
3	1	64	54	3	1	63	50
vi		69	49	vi		68	47
1	3	75	04	1	3	73	55
2	2	80	37	2	2	79	24
3	1	86	24	3	1	85	10

South Declin. 19 00 Subst. distance 14 31 Stiles Height 36 03				South Declin. 20 00 Subst. distance 15 13 Stiles Height 35 48		
Hours.		**d**	**m**	**Hours.**		**d**	**m**
1	3	85	57	1	3	85	18
2	2	75	36	2	2	81	04
3	1	71	12	3	1	78	34
viii	iiii	61	57	viii	iiii	66	12
1	3	58	48	1	3	59	58
2	2	52	55	2	2	53	57
3	1	47	19	3	1	48	14
ix	iii	42	01	ix	iii	42	08
1	3	37	06	1	3	37	47
2	2	32	39	2	2	33	04
3	1	28	13	3	1	28	32
x	ii	24	41	x	ii	24	37
1	3	20	31	1	3	20	49
2	2	17	04	2	2	17	19
3	1	13	49	3	1	13	59
xi	i	10	46	xi	i	10	54
1	3	07	52	1	3	07	57
2	2	05	08	2	2	05	11
3	1	02	31	3	1	02	22
xii		00	00	xii		00	00
1	3	02	05	1	3	02	26
2	2	04	57	2	2	04	48
3	1	07	05	3	1	07	06
i	xi	09	23	i	xi	09	22
I	3	11	32	I	3	11	36

Declining 19 Deg.				Declining 20 Deg.			
2	2	13	57	2	2	13	47
3	1	15	59	1	3	15	59
ii	x	18	11	ii	x	18	11
1	3	20	27	1	1	20	23
2	2	22	43	2	2	22	38
3	1	25	01	3	3	24	56
iii	ix	27	34	iii	ix	27	16
1	3	30	11	1	3	29	41
2	2	32	25	2	2	31	41
3	1	35	05	3	1	34	58
iiii	viii	37	33	iiii	viii	37	52
1	3	41	12	1	3	40	24
2	2	43	55	2	2	43	44
3	1	47	12	3	1	46	41
v	vii	50	46	v	vii	50	09
1	3	54	35	1	3	53	51
2	2	58	38	2	2	57	50
3	1	63	01	3	1	62	07
	vi	67	44		vi	66	42
1	3	72	47	1	3	71	40
2	2	78	09	2	2	76	58
3	1	83	52	3	1	82	36
vii	v	89	52	vii	v	88	32

South Declin. 21 00		South Declin. 22 00	
Subst. distance 15 54		Subst. distance 16 36	
Stiles Height 35 31		Stiles Height 35 16	

Hours		d.	m.	Hours		d.	m.
1	3	86	45	1	3	88	35
2	2	80	20	2	2	81	36
3	1	75	54	3	1	75	13
viii	iiii	67	28	viii	iiii	68	44
1	3	62	08	1	3	62	20
2	2	54	01	2	2	56	06
3	1	49	10	3	1	50	09
ix	iii	43	38	ix	iii	44	28
1	3	38	38	1	3	39	10
2	2	33	37	2	2	34	17
3	1	29	06	3	1	29	38
x	ii	24	59	x	ii	25	22
1	3	21	09	1	3	21	25
2	2	17	31	2	2	17	41
3	1	14	09	3	1	14	19
xi	i	10	57	xi	i	11	07
1	3	08	02	1	3	08	06
2	2	05	14	2	2	05	16
3	1	02	34	3	1	02	34
xii		00	00	xii		00	00
1	3	02	28	1	3	02	30
2	2	04	50	2	2	04	52
3	1	07	31	3	1	07	10
i	xi	09	21	i	xi	09	26
1	3	11	36	1	3	11	39

Declining 21 Deg				Declining 22 Deg			
2	2	13	27	2	2	13	50
3	1	15	58	3	1	16	00
ii	x	18	08	ii	x	18	10
1	3	20	21	1	3	20	14
2	2	22	34	2	2	22	32
3	1	24	49	3	1	24	46
iii	ix	27	08	iii	x	27	02
1	3	29	30	1	3	29	23
2	2	31	59	2	2	31	48
3	1	34	31	3	1	34	19
iiii	viii	37	12	iiii	viii	36	55
1	3	40	01	1	3	39	42
2	2	42	59	2	2	42	36
3	1	46	09	3	1	45	42
v	vii	49	32	v	vii	49	02
1	3	53	08	1	3	52	29
2	2	57	02	2	2	56	19
3	1	61	11	3	1	60	24
vi		65	43	vi		64	48
1	3	70	34	1	3	69	33
2	2	75	46	2	2	74	39
3	1	81	19	3	1	80	07
vii	v	87	11	vii	v	85	54

South Declin. 23 00			South Declin. 24 00		
Subst. distance 17 16			Subst. distance 17 56		
Stiles Height 34 57			Stiles Height 34 39		

Hours.		d.	m.	Hours.		d.	m.
I	3	89	21	2	2	82	29
2	2	83	06	3	1	78	00
3	1	76	38	viii	iiii	71	25
viii	iiii	70	05	I	3	64	51
I	3	63	36	2	2	58	24
2	2	57	15	3	1	52	11
3	1	51	09	ix	iii	46	16
ix	iii	45	21	I	3	40	43
I	3	39	57	2	2	35	30
2	2	34	51	3	1	30	41
3	1	30	09	x	ii	26	11
x	ii	25	47	I	3	21	53
I	3	21	44	2	2	18	15
2	2	18	00	3	1	14	41
3	1	14	30	xi	i	11	23
xi	i	11	15	I	3	08	16
I	3	08	11	2	2	05	21
2	2	05	19	3	1	02	36
3	1	02	35	xii		00	00
xii		00	00	I	3	02	31
I	3	02	29	2	2	04	54
2	2	04	53	3	1	07	14
3	1	07	12	i	xi	09	29
i	xi	09	27	I	3	11	41
I	3	11	39	2	2	13	53

Declining 23 Deg				Declining 24 Deg			
2	2	13	50	2	2	13	52
3	1	16	00	3	1	16	04
ii	x	18	08	ii	x	18	09
1	3	20	17	1	3	20	16
2	2	22	25	2	2	22	26
3	1	24	41	3	1	24	36
iii	ix	26	55	iii	x	26	50
1	3	29	13	1	3	29	05
2	2	31	39	2	2	31	25
3	1	34	03	3	1	33	50
iiii	viii	36	37	iiii	viii	36	21
1	3	39	19	1	3	39	00
2	2	42	08	2	2	41	46
3	1	45	11	3	1	44	44
v	vii	48	24	v	vii	47	50
1	3	51	50	1	3	51	14
2	2	56	34	2	2	54	50
3	1	59	31	3	1	58	44
	vi	63	49		vi	62	55
1	3	68	28	1	3	67	27
2	2	73	28	2	2	72	21
3	1	78	50	3	1	77	04
vii	v	84	34	vii	v	83	16
				1	3	89	15

South Declin. 25 00	South Declin. 26 00
Subst. distance 18 37	Subst. distance 19 13
Stiles Height 34 21	Stiles Height 34 01

Hours.		d	m	Hours.		d.	m.
2	2	84	51	2	2	87	20
3	1	79	24	3	1	80	54
viii	iiii	73	10	viii	iiii	75	08
1	3	66	08	1	3	67	32
2	2	59	36	2	2	61	40
3	1	53	16	3	1	54	30
ix	iii	47	12	ix	iii	48	14
1	3	41	30	1	3	42	57
2	2	36	11	2	2	36	55
3	1	31	14	3	1	31	51
x	ii	26	39	x	ii	27	09
1	3	22	25	1	3	22	49
2	2	18	31	2	2	18	49
3	1	14	54	3	1	15	06
xi	i	11	30	xi	i	11	40
1	3	08	21	1	3	08	30
2	2	05	24	2	2	05	29
3	1	02	39	3	1	02	40
	xii	00	00		xii	00	00
1	3	02	31	1	3	02	11
2	2	04	58	2	2	04	59
3	1	07	17	3	1	07	34
i	xi	09	31	i	xi	09	35
1	3	11	44	1	3	11	54
2	2	13	55	2	2	13	01

Declining 25 Deg.				Declining 26 Deg.			
3	I	16	04	3	I	16	02
ii	x	18	55	ii	x	18	08
1	3	20	17	1	3	20	14
2	2	22	24	2	2	22	46
3	1	24	55	3	1	24	28
iii	ix	26	45	iii	ix	27	01
1	3	28	59	1	3	29	12
2	2	31	18	2	2	31	28
3	1	33	40	3	1	33	48
iiii	viii	36	08	iiii	viii	36	14
1	3	39	09	1	3	38	45
2	2	41	21	2	2	41	24
3	1	44	24	3	1	44	13
v	vii	47	24	v	vii	47	13
1	3	50	40	1	3	50	24
2	2	54	11	2	2	53	50
3	1	58	06	3	1	57	31
vi		62	05	vi		61	31
1	3	66	31	1	3	67	04
2	2	71	18	2	2	71	50
3	1	76	28	3	1	77	01
vii	v	82	01	vii	v	81	04
1	3	87	55	1	3	85	54

South Declin. 27 00		South Declin. 28 00	
Subst. distance 19 50		Subst. distance 20 29	
Stiles Height 33 42		Stiles Height 33 20	

Hours.		d	m	Hours.		d	m
2	2	88	45	3	1	84	41
3	1	82	20	viii	iiii	77	07
viii	iiii	75	41	1	2	70	51
1	3	68	20	2	3	63	42
2	2	62	12	3	1	56	47
3	1	55	38	ix	iii	50	24
1	iii	49	19	1	3	44	14
1	3	43	20	2	2	38	29
2	2	37	43	3	1	33	08
3		32	36	x	ii	28	11
x	ii	27	41	1	3	23	48
1	3	23	00	2	2	19	27
2	2	19	08	3	1	15	45
3	1	15	22	xi	i	11	57
xi	i	11	51	1	3	08	41
1	3	08	37	2	2	05	37
2	2	05	34	3	1	02	43
3	1	02	38	xii		00	00
	xii	00	00	1	3	02	34
1	3	02	06	2	2	05	02
2	2	04	58	3	1	07	23
3	1	07	19	i	xi	09	38
i	xi	09	34	1	3	12	51
1	3	11	47	2	2	13	59
2	2	13	55	3	1	16	25

Declining 27 Deg				Declining 28 Deg			
3	1	16	04	ii	x	18	10
ii	x	18	10	1	3	20	14
1	3	20	14	2	2	22	18
2	2	22	18	3	1	24	24
3	1	24	24	iii	ix	26	29
iii	ix	25	32	1	3	28	37
1	3	28	41	2	2	30	47
2	2	31	59	3	1	33	03
3	1	33	12	iiii	viii	35	23
iiii	viii	35	35	1	3	37	47
1	3	38	04	2	2	40	19
2	2	41	40	3	1	43	01
3	1	43	24	v	vii	45	53
v	vii	46	19	1	3	48	54
1	3	49	26	2	2	52	10
2	2	52	47	3	1	55	40
3	1	56	23		vi	59	27
	vi	60	16	1	3	63	34
1	3	65	40	2	2	68	00
2	2	70	11	3	1	72	54
3	1	74	10	vii	v	78	08
vii	v	79	24	1	3	83	48
1	3	85	09	2	2	89	51

South Declin. 29 00				South Declin. 30 00			
Subst. distance 21 05				Subst. distance 21 40			
Stiles Height 37 59				Stiles Height 32 37			
Hours.		d.	m.	Hours.		d.	m.
3	1	85	16	3	1	86	45
viii	iiii	78	37	viii	iiii	81	07
1	3	71	12	1	2	73	15
2	2	64	55	2	3	66	20
3	1	58	07	3	1	59	25
ix	iii	51	31	ix	iii	52	41
1	3	45	14	1	3	46	15
2	2	39	19	2	2	40	12
3	1	33	49	3	1	34	36
x	ii	28	45	x	ii	29	20
1	3	24	04	1	3	24	32
2	2	19	47	2	2	20	08
3	1	15	50	3	1	16	06
xi	i	12	11	xi	i	12	32
1	3	08	45	1	3	08	57
2	2	05	24	2	2	05	46
3	1	02	45	3	1	02	47
xii		00	00	xii		00	00
1	3	02	35	1	3	02	36
2	2	05	06	2	2	05	05
3	1	07	25	3	1	07	27
i	xi	09	12	i	xi	09	43
1	3	11	53	1	3	10	56
2	2	14	02	2	2	14	04
1	3	16	07	1	3	16	08

Declining 29 Deg				Declining 30 Deg			
ii	ix	18		ii	x	18	12
1	3	20	11	1	3	20	14
2	2	22	16	2	2	22	
3	1	24	19	3	1	24	17
iii	ix	26	23	iii	ix	26	19
1	3	28	30	1	3	28	
2	2	30	59	2	2	30	30
3	1	32	51	3	1	32	40
iiii	viii	35	08	iiii	viii	34	54
1	3	37	30	1	3	37	
2	2	39	59	2	2	39	40
3	1	42	37	3	1	42	
v	vii	45	24	v	vii	44	56
1	3	48	21	1	2	47	49
2	2	51	34	2	2	50	55
3	1	54	50	3	1	54	14
vi		58	37	vi		57	49
1	3	62	39	1	3	60	43
2	2	65	59	2	2	65	58
3	1	71	43	3	1	70	35
vii	v	76	51	vii	v	75	38
1	3	81	25	1	3	81	05
2	2	85	24	2	2	87	00
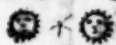
South Declin. 31 00			South Declin. 32 00		
Subst. distance 22 15			Subst. distance 22 50		
Stiles Height 32 15			Stiles Height 31 2		

Hours.		d	m	Hours.		d	m
3	1	88	14	3	1	89	42
viii	iiii	81	39	viii	iiii	83	10
10	3	75	06	1	2	76	15
2	2	67	47	2	3	69	15
3	1	60	47	3	1	62	10
ix	iii	54	55	ix	iii	56	10
1	3	47	20	1	3	49	26
2	2	41	07	2	2	42	03
3	1	35	19	3	1	36	05
x	ii	29	57	x	ii	30	35
1	3	25	02	1	3	25	31
2	2	20	31	2	2	20	54
3	1	16	23	3	1	16	40
xi	i	12	36	xi	i	12	36
1	3	09	05	1	3	09	12
2	2	05	51	2	3	05	55
3	1	02	50	3	1	02	54
xii		00	00	xii		00	00
1	3	02	37	1	3	02	39
2	2	04	07	2	2	05	0
3	1	07	30	3	1	07	34
i	xi	09	47	i	xi	09	51
1	3	11	58	1	3	12	02
2	2	14	06	2	2	14	11
3	1	16	11	3	1	16	15

Declining 31 Deg.				Declining 32 Deg.		
ii	x	18	13	ii	x	18	05
1	3	25	14	1	3	20	16
2	2	22	14	2	2	22	15
3	1	24	15	3	1	24	14
iii	ix	26	15	iii	ix	26	14
1	3	28	16	1	3	28	14
2	2	30	23	2	2	30	17
3	1	32	30	3	1	32	22
ii.i	viii	34	44	iii	viii	34	31
1	3	36	59	1	3	36	15
2	2	39	22	2	2	39	05
3	1	41	52	3	1	41	31
v	vii	44	30		vii	44	05
1	3	47	19	1	3	46	53
2	2	50	14	2	2	49	45
3	1	53	34	3	1	52	54
vi		57	02	vi		56	19
1	3	60	53	1	3	61	03
2	2	64	58	2	2	64	02
3	1	69	30	3	1	68	25
vii	v	74	24	vii	v	73	14
1	3	79	45	1	3	78	28
2	2	85	34	2	2	84	10
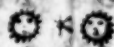
South Declin. 33 00			South Declin. 34 00		
Subst. distance 23 25			Subst. distance 23 59		
Stiles Height 31 27			Stiles Height 31 04		

Hours.		d.	m.	Hours.		d.	m.
viii	iiii	84	42	viii	iiii	86	15
1	3	77	54	1	3	79	25
2	2	70	46	2	2	72	20
3	1	63	35	3	1	65	05
ix	iii	56	28	ix	iii	57	51
1	3	49	35	1	3	50	49
2	2	43	02	2	2	44	05
3	1	36	54	3	1	37	47
x	ii	31	14	x	ii	31	57
1	3	26	02	1	3	26	36
2	2	21	17	2	2	21	44
3	1	17	35	3	1	17	15
xi	i	12	58	xi	i	13	11
1	3	09	20	1	3	09	29
2	2	06	59	2	2	06	04
3	1	02	44	3	1	02	55
xii		00	00	xii		00	00
1	3	02	41	1	3	02	44
2	2	05	09	2	2	05	17
3	1	07	38	3	1	07	42
i	xi	09	55	i	xi	09	59
1	3	12	07	1	3	12	12
2	2	14	16	2	2	14	19
3	1	16	19	3	1	16	23
ii	x	18	20	ii	x	18	23

Declining 33 Deg.				Declining 34 Deg.		
1	3	20	14	1	3	20	21
2	2	22	17	2	2	22	18
3	1	24	14	3	1	24	14
iii	ix	26	12	iii	ix	26	10
1	3	28	11	1	3	28	08
2	2	30	11	2	2	30	05
3	1	31	16	3	1	32	07
iiii	viii	34	24	iiii	viii	34	11
1	3	36	34	1	3	36	20
2	2	38	44	2	2	38	34
3	1	40	12	3	1	40	54
v	vii	43	42	v	vii	43	20
1	3	45	13	1	3	45	50
2	2	48	14	2	2	48	42
3	1	52	17	3	1	51	09
	vi	55	36		vi	54	54
1	3	59	11	1	3	57	56
2	2	63	05	2	2	61	11
3	1	67	12	3	1	66	19
vii	v	72	04	vii	v	70	54
1	3	76	34	1	3	75	54
2	2	82	45	2	2	81	21
3	1	83	50	3	1	83	18

South Declin. 35 00			South Declin. 36 00		
Subst. distance 24 31			Subst. distance 25 04		
Stiles Height 30 40			Stiles Height 30 14		

Hours.		d.	m.	Hours.		d.	m.
viii	iiii	87	47	viii	iiii	89	18
1	3	80	56	1	3	81	36
2	2	73	54	2	2	75	29
3	1	66	46	3	1	68	08
ix	iii	59	16	ix	iii	60	42
1	3	52	06	1	3	53	21
2	2	45	11	2	2	46	11
3	1	38	42	3	1	39	37
x	ii	32	42	x	ii	33	28
1	3	27	11	1	3	27	47
2	2	22	10	2	2	22	35
3	1	17	36	3	1	17	56
xi	i	13	26	xi	i	13	40
1	3	09	36	1	3	09	46
2	2	06	10	2	2	06	14
3	1	02	58	3	1	02	59
xii		00	00	xii		00	00
1	3	02	45	1	3	02	50
2	2	05	19	2	2	05	44
3	1	07	45	3	1	07	51
i	xi	10	07	i	xi	10	10
1	3	12	16	1	3	12	22
2	2	14	13	2	2	14	29
3	1	16	26	3	1	16	22
ii	x	18	27	ii	x	18	32

Declining 35 Deg.				Declining 36 Deg.			
1	3	20	24	1	3	23	27
2	2	22	12	2	2	22	21
3	1	24	14	3	1	24	15
iii	ix	26	80	iii	ix	26	09
1	3	28	05	1	3	28	01
2	2	30	01	2	2	30	00
3	1	32	00	3	1	31	5?
iiii	viii	34	02	iiii	viii	33	54
1	3	36	07	1	3	35	56
2	2	38	18	2	2	38	01
3	1	40	35	3	1	40	17
v	vii	42	58	v	vii	42	37
1	3	45	29	1	3	45	04
2	2	48	11	2	2	47	41
3	1	51	05	3	1	50	31
	vi	54	12		vi	53	33
1	3	57	34	1	3	56	50
2	2	61	17	2	2	60	24
3	1	65	20	3	1	64	31
vii	v	69	46	vii	v	68	41
1	3	74	49	1	3	73	25
2	2	80	01	2	2	78	41
3	1	85	51	3	1	84	25

South Declin. 37 00		South Declin. 38 00	
Subst. distance 25 35		Subst. distance 26 04	
Stiles Height 29 48		Stiles Height 29 22	

Hours.		d	m	Hours.		d	m
1	3	84	06	1	3	85	57
2	2	77	10	2	2	78	54
3	1	69	46	3	1	71	29
ix	iii	62	14	ix	iii	63	52
1	3	54	46	1	3	56	16
2	2	47	31	2	2	48	51
3	1	40	40	3	1	41	48
x	ii	34	18	x	ii	35	15
1	3	28	27	1	3	29	11
2	2	21	07	2	2	23	43
3	1	18	17	3	1	18	45
xi	i	14	55	xi	i	14	14
1	3	09	57	1	3	10	11
2	2	06	20	2	2	06	29
3	1	03	02	3	1	03	07
	xii	00	00		xii	00	00
1	3	02	36	1	3	02	49
2	2	05	27	2	2	05	28
3	1	07	55	3	1	07	53
i	xi	10	14	i	xi	10	17
1	3	12	26	1	3	12	38
2	2	14	34	2	2	14	35
3	1	16	35	3	1	16	38
ii	x	18	36	ii	x	18	56
1	3	20	30	1	3	20	30

Declining 37 Deg.				Declining 38 Deg.			
2	2	22	23	3	2	24	24
2	1	24	15	3	1	24	14
iii	ix	26	07	iii	ix	26	05
1	3	28	00	1	3	27	56
2	2	29	52	2	2	29	57
3	1	31	50	3	1	31	40
iiii	viii	33	45	iiii	viii	33	34
1	3	35	45	1	3	35	32
2	2	37	49	2	2	37	04
3	1	39	53	3	1	39	41
v	vii	42	16	v	vii	41	55
1	3	45	15	1	3	44	14
2	2	47	14	2	2	46	41
3	1	49	56	3	1	49	22
	vi	52	54		vi	52	14
1	3	56	04	1	3	55	19
2	2	59	26	2	2	58	41
3	1	63	22	3	1	62	24
vii	v	67	35	vii	v	66	27
1	3	73	11	1	3	70	57
2	2	77	18	2	2	75	56
3	1	82	56	3	1	81	25
viii	iiii	89	05	viii	iiii	87	28

South Declin. 39 00	South Declin. 40 00
Subst. distance 25 35	Subst. distance 27 03
Stiles Height 28 56	Stiles Height 28 29

Hours.		d.	m.	Hours.		d.	m.
I	3	87	49	I	3	88	54
2	2	80	34	2	2	82	26
3	1	73	08	3	1	75	18
ix	iii	65	27	ix	iii	67	05
I	3	57	44	I	3	59	20
2	2	50	08	2	2	51	31
3	1	42	53	3	1	44	07
x	ii	36	07	x	ii	37	07
I	3	29	54	I	3	30	41
2	2	23	09	2	2	25	51
3	1	18	54	3	1	19	40
xi	i	14	31	xi	i	14	53
I	3	10	24	I	3	10	34
2	2	07	31	2	2	06	44
3	1	03	09	3	1	03	14
	xii	00	00		xii	00	00
I	3	02	52	I	3	02	54
2	2	05	32	2	2	05	40
3	1	08	04	3	1	08	06
i	xi	10	24	i	xi	10	27
I	3	12	36	I	3	12	51
2	2	14	44	2	2	14	47
3	1	16	44	3	1	16	49
ii	x	18	42	ii	x	18	48
I	3	20	37	I	3	20	35

Declining 39 Deg.				Declining 40 Deg.			
2	2	22	35	2	2	22	29
3	1	24	07	3	1	24	17
iii	ix	26	07	iii	ix	26	05
1	3	27	55	1	3	28	51
2	2	29	45	2	2	29	41
3	1	31	35	3	1	31	40
iiii	viii	33	28	iiii	viii	33	29
1	3	35	24	1	3	35	14
2	2	37	23	2	2	37	10
3	1	39	27	3	1	39	11
v	vii	41	36	v	vii	41	27
1	3	43	53	1	3	43	30
2	2	44	24	2	2	45	49
3	1	48	52	3	1	48	20
	vi	51	38		vi	51	02
1	3	54	38	1	3	53	24
2	2	57	55	2	2	57	06
3	1	61	29	3	1	60	34
vii	v	65	26	vii	v	64	24
1	3	69	49	1	3	68	38
2	2	74	50	2	2	72	21
3	1	80	02	3	1	78	36
viii	iiii	85	57	viii	iiii	84	23

South Declin. 41 00		South Declin. 42 00	
Subst. distance 27 33		Subst. distance 28 01	
Stiles Height 28 01		Stiles Height 27 33	

Hours.		d.	m.	Hours.		d.	m.
2	2	83	58	2	2	85	44
3	1	76	34	3	1	78	16
ix	iii	68	49	ix	iii	70	01
1	3	60	42	1	3	62	30
2	2	52	45	2	2	54	27
3	1	45	05	3	1	46	36
x	ii	37	51	x	ii	39	11
1	3	31	14	1	3	32	20
2	2	25	11	2	2	26	05
3	1	19	46	3	1	20	29
xi	i	14	54	xi	i	15	28
1	3	11	34	1	3	10	51
2	2	06	37	2	2	06	57
3	1	03	04	3	1	03	18
xii		00	00	xii		00	00
1	3	03	02	1	3	03	01
2	2	05	74	2	2	05	56
3	1	08	21	3	1	08	18
i	xi	10	40	i	xi	10	30
1	3	12	56	1	3	12	58
2	2	14	58	2	2	15	01
3	1	16	59	3	1	17	01
ii	x	18	55	ii	x	19	00
1	3	20	47	1	3	20	50

Declining 41 Deg.				Declining 42 Deg.			
2	2	22	40	2	2	22	28
3	1	24	22	2	1	24	25
iii	ix	26	08	iii	ix	26	10
1	3	27	54	1	3	27	58
2	2	29	40	2	2	29	48
3	1	31	27	3	1	31	23
iiii	viii	33	15	iiii	viii	33	09
1	3	35	05	1	3	34	58
2	2	37	00	2	2	36	44
3	1	38	57	3	1	38	43
v	vii	41	00	v	vii	40	41
1	3	43	10	1	3	42	50
2	2	45	26	2	2	45	02
3	1	47	52	3	1	47	24
	vi	50	30		vi	49	25
1	3	53	15	1	3	52	29
2	2	56	21	2	2	55	38
3	1	59	43	3	1	58	34
vii	v	63	25	vii	v	62	27
1	3	67	31	1	3	66	26
2	2	72	06	2	2	70	53
3	1	77	11	3	1	75	50
viii	iiii	82	52	viii	iiii	81	21

South Declin. 43 00			South Declin. 44 00		
Subst. distance 28 29			Subst. distance 28 55		
Stiles Height 27 05			Stiles Height 26 36		

Hours,		d.	m.	Hours.		d.	m.
2	2	87	29	2	2	89	15
3	1	78	09	3	1	82	03
ix	iii	72	25	ix	iii	74	15
1	3	64	16	1	3	66	01
2	2	56	03	2	2	55	34
3	1	48	00	3	1	49	15
x	ii	40	19	x	ii	41	20
1	3	33	07	1	3	35	03
2	2	26	41	2	2	27	20
3	1	21	01	3	1	21	20
xi	i	15	50	xi	i	16	03
1	3	11	31	1	3	11	17
2	2	07	05	2	2	07	03
3	1	03	11	3	1	03	18
xii		00	00	xii		00	00
1	3	03	02	1	3	03	15
2	2	05	49	2	2	06	05
3	1	08	29	3	1	08	38
i	xi	10	55	i	xi	11	0
1	3	13	08	1	3	13	30
2	2	15	15	2	2	15	21
3	1	17	04	3	1	17	20
ii	x	19	04	ii	x	19	14
1	3	20	54	1	3	21	01

Declining 43 Deg.				Declining 44 Deg.			
2	2	22	35	2	2	22	48
3	1	24	00	3	1	24	49
iii	ix	26	12	iii	ix	26	41
1	3	27	55	1	3	27	55
2	2	29	26	2	2	29	35
3	1	31	20	3	1	31	16
iiii	viii	33	07	iiii	viii	33	15
1	3	34	55	1	3	34	55
2	2	36	44	2	2	36	55
3	1	38	33	3	1	38	23
v	vii	40	28	v	vii	40	15
1	3	42	31	1	3	42	14
2	2	44	40	2	2	44	14
3	1	46	57	3	1	46	32
	vi	48	54		vi	48	51
1	3	52	00	1	3	51	25
2	2	54	53	2	2	54	13
3	1	58	00	3	1	57	15
vii	v	61	31	vii	v	60	32
1	3	65	21	1	3	64	21
2	2	67	39	2	2	68	28
3	1	74	27	3	1	73	09
viii	iiii	79	51	viii	iiii	87	24
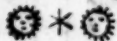
South Declin. 45 00			South Declin. 46 00		
Subſt. diſtance 29 21			Subſt. diſtance 29 45		
Stiles Height 26 07			Stiles Height 25 37		

Hours.		d.	m.	Hours.		d.	m.
3	I	83	53	3	I	86	53
ix	iii	76	08	ix	iii	78	04
1	3	68	02	1	3	69	48
2	2	59	18	2	2	61	17
3	1	51	04	3	1	53	34
x	ii	43	06	x	ii	44	11
1	3	35	06	1	3	36	24
2	2	28	08	2	2	29	12
3	1	22	09	3	1	23	22
xi	i	16	37	xi	i	17	03
1	3	11	36	1	3	11	55
2	2	07	15	2	2	07	32
3	1	03	23	3	1	03	33
xii		00	00	xii		00	00
1	3	03	19	1	3	03	11
2	2	05	52	2	2	06	05
3	1	08	37	3	1	08	43
i	xi	11	02	i	xi	11	09
1	3	13	22	1	3	13	25
2	2	15	23	2	2	15	31
3	1	17	21	3	1	17	31
ii	x	19	18	ii	x	19	35
1	3	21	03	1	3	21	14

	Declining 45 Deg.				Declining 46 Deg.		
00	2	2	22	57	2	2	22	58
46	3	1	24	3+	3	1	24	43
37	iii	ix	26	55	iii	ix	26	20
m.	1	3	27	56	1	3	28	00
53	2	2	29	36	2	2	29	36
04	3	1	31	1+	3	1	31	13
48	iiii	viii	32	55	iiii	viii	32	51
17	1	3	34	36	1	3	34	34
34	2	2	36	20	2	2	36	11
11	3	1	37	51	3	1	37	56
24	v	vii	39	58	v	vii	39	43
12	1	3	41	42	1	3	41	35
22	2	2	43	24	2	2	43	52
03	3	1	45	31	3	1	45	28
55		vi	48	22		vi	47	52
32	1	3	50	49	1	3	50	15
33	2	2	53	30	2	2	52	51
00	3	1	56	26	3	1	55	41
11	vii	v	59	41	vii	v	58	46
05	1	3	63	15	1	3	62	15
43	2	2	67	17	2	2	68	18
09	3	1	71	47	3	1	70	27
25	viii	iiii	76	52	viii	iiii	75	24
31								
31								
35								
14								
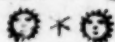
South Declin. 47 co	South Declin. 48 00
Subst. diftance 30 11	Subft. diftance 30 35
Stiles Height 25 07	Stiles Height 24 38

Hours.		d.	m.	Hours.		d.	m.
3	1	87	46	3	1	88	31
ix	iii	78	49	ix	iii	80	04
1	3	71	40	1	3	73	46
2	2	63	10	2	2	65	03
3	1	54	14	3	1	56	00
x	ii	45	45	x	ii	47	10
1	3	37	30	1	3	38	47
2	2	30	06	2	2	31	04
3	1	23	47	3	1	24	09
xi	i	17	28	xi	i	18	01
1	3	12	11	1	3	12	44
2	2	07	40	2	2	07	53
3	1	03	39	3	1	03	43
xii		00	00	xii		00	00
1	3	03	15	1	3	03	18
2	2	06	11	2	2	06	16
3	1	08	51	3	1	08	57
i	xi	11	19	i	xi	11	25
1	3	13	48	1	3	13	42
2	2	15	59	2	2	15	48
3	1	17	42	3	1	17	48
ii	x	19	34	ii	x	19	49
1	3	21	21	1	3	21	28

Declining 47 Deg.				Declining 48 Deg.			
2	2	23	04	2	2	23	11
3	1	24	51	3	1	24	53
iii	ix	26	24	iii	ix	26	27
1	3	28	00	1	3	28	03
2	2	29	36	2	2	29	37
3	1	31	12	3	1	30	58
iiii	viii	32	41	iiii	viii	32	44
1	3	34	22	1	3	34	20
2	2	36	03	2	2	35	55
3	1	37	42	3	1	37	34
v	vii	39	29	v	vii	39	16
1	3	41	17	1	3	41	03
2	2	43	12	2	2	42	54
3	1	45	11	3	1	44	51
	vi	47	22		vi	45	56
1	3	49	38	1	3	49	10
2	2	51	11	2	2	51	35
3	1	53	55	3	1	54	15
vii	v	57	53	vii	v	57	05
1	3	61	55	1	3	60	29
2	2	65	11	2	2	63	56
3	1	69	11	3	1	67	39
viii	iiii	74	05	viii	iiii	71	29

South Declin. 49 00			South Declin. 50 00		
Subst. distance 30 58			Subst. distance 31 21		
Stiles Height 24 00			Stiles Height 23 35		

Hours.		d.	m.	Hours.		d.	m.
ix	iii	85	12	ix	iii	86	01
1	3	76	48	1	3	77	55
2	2	67	00	2	2	67	49
3	1	57	55	3	1	58	27
x	ii	48	45	x	ii	50	27
1	3	40	06	1	3	41	28
2	2	32	04	2	2	33	09
3	1	24	49	3	1	25	41
xi	i	18	32	xi	i	19	04
1	3	13	54	1	3	13	19
2	2	08	05	2	2	08	14
3	1	03	48	3	1	03	51
xii		00	00	xii		00	00
1	3	03	22	1	3	03	26
2	2	06	22	2	2	06	29
3	1	09	04	3	1	09	14
i	xi	11	35	i	xi	11	45
1	3	13	56	1	3	14	01
2	2	15	49	2	2	16	10
3	1	17	57	ii	1	18	07
ii	x	19	45	3	x	19	55
1	3	21	38	1	3	21	3

Declining 49 Deg.				Declining 50 Deg.			
2	2	23	18	2	2	23	24
3	1	24	40	3	1	24	44
iii	ix	26	28	iii	ix	26	27
1	3	28	05	1	3	28	09
2	2	29	39	2	2	29	40
3	1	31	13	3	1	31	11
iiii	viii	32	45	iiii	viii	32	42
1	3	34	16	1	3	34	11
2	2	35	58	2	2	35	43
3	1	37	25	3	1	37	16
v	vii	38	58	v	vii	38	53
1	3	40	47	1	3	40	33
2	3	42	35	2	2	42	18
3	1	44	30	3	1	44	08
	vi	46	30		vi	46	24
1	3	48	40	1	3	48	19
2	2	50	59	2	2	50	24
3	1	53	57	3	1	52	51
vii	v	56	35	vii	v	55	32
1	3	59	25	1	3	58	31
2	2	62	53	2	2	61	50
3	1	66	47	3	1	65	35
viii	iiii	71	09	viii	iiii	69	17
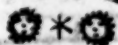
South Declin. 51 00			South Declin. 52 00		
Subst. distance 31 45			Subst. distance 32 05		
Stiles Height 23 04			Stiles Height 22 32		

Hours.		d.	m.	Hours.		d.	m.
ix	iii	86	45	1	3	85	16
1	3	77	58	2	2	74	12
2	2	69	07	3	1	64	5
3	1	62	42	x	ii	54	0
x	ii	51	30	1	3	44	2
1	3	43	12	2	2	35	17
2	2	34	14	3	1	27	17
3	1	26	29	xi	i	20	05
xi	i	19	35	1	3	12	5
1	3	13	37	2	2	08	35
2	2	08	22	3	1	03	53
3	1	03	55	xii		00	00
xii		00	00	1	3	03	41
1	3	03	32	2	2	06	5
2	2	06	42	3	1	09	41
3	1	09	27	i	xi	12	11
i	xi	11	56	1	3	14	27
1	3	14	13	2	2	16	35
2	2	16	20	3	1	18	30
3	1	18	20	ii	x	20	17
ii	x	20	09	1	3	21	05
1	3	21	48				

Declining 51 Deg.				Declining 52 Deg.			
2	2	23	33	2	2	23	4
3	1	25	04	3	1	25	2
iii	ix	26	46	iii	ix	26	47
1	3	28	15	1	3	28	18
2	2	29	46	2	2	29	47
3	1	31	10	3	1	31	13
iiii	viii	32	43	iiii	viii	32	39
1	3	34	10	1	3	34	05
2	2	35	30	2	2	35	33
3	1	37	12	3	1	36	51
v	vii	38	45	v	vii	38	33
1	3	40	21	1	3	40	08
2	2	42	03	2	2	41	45
3	1	43	50	3	1	43	28
vi		45	49	vi		45	18
1	3	47	44	1	3	47	15
2	2	49	53	2	2	49	23
3	1	52	14	3	1	51	35
vii	v	54	47	vii	v	54	05
1	3	57	44	1	3	56	49
2	2	58	52	2	2	9	24
3	1	6	28	3	1	63	05
viii	iiii	68	41	viii	iiii	67	39

South Declin. 53 00			South Declin. 54 00		
Subſt. diſtance 32 26			Subſt. diſtance 32 46		
Stiles Height 22 00			Stiles Height 21 28		

Hours.		*d.*	*m.*	*Hours.*		*d.*	*m.*
I	3	85	44	I	3	86	22
2	2	75	49	2	2	78	00
3	1	66	04	3	1	68	20
X	ii	56	03	X	ii	58	00
I	3	46	03	I	3	47	51
2	2	37	04	2	2	38	14
3	1	28	14	3	1	29	19
xI	i	22	54	xi	i	23	40
I	3	14	15	I	3	15	29
2	2	08	44	2	2	09	44
3	1	04	04	3	1	04	59
xii		00	00	xii		00	00
I	3	03	47	I	3	03	50
2	2	07	01	2	2	07	06
3	1	09	50	3	1	09	56
i	xi	12	14	i	xi	12	24
I	3	14	41	I	3	14	53
2	2	16	45	2	2	16	57
3	1	18	43	3	1	18	47
iii	x	20	29	ii	x	20	40
I	3	22	18	I	3	22	25

Declining 53 Deg.				Declining 54 Deg.			
2	2	23	48	2	2	24	03
2	1	25	06	3	1	25	30
iii	ix	26	55	iii	ix	27	02
1	3	28	08	1	3	28	31
2	2	29	51	2	2	29	54
3	1	31	15	3	1	31	16
iiii	viii	32	38	iiii	viii	32	53
1	3	33	41	1	3	34	00
2	2	35	28	2	2	35	23
3	1	36	58	3	1	36	45
v	vii	38	12	v	vii	38	14
1	3	39	53	1	3	39	41
2	2	41	29	2	2	41	13
3	1	43	12	3	1	42	49
	vi	45	52		vi	44	32
1	3	46	43	1	3	46	21
2	2	48	44	2	2	48	11
3	1	50	39	3	1	50	21
vii	v	53	19	vii	v	52	36
1	3	55	56	1	3	55	09
2	2	58	52	2	2	58	00
3	1	62	08	3	1	61	05
viii	iiii	66	00	viii	iiii	64	45
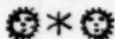
South Declin. 55 00				South Declin. 56 00			
Subst. distance 33 06				Subst. distance 33 24			
Stiles Height 20 55				Stiles Height 20 22			

Hours.		d.	m.	Hours.		d.	m.
1	3	88	49	1	3	88	56
2	2	80	18	2	2	82	38
3	1	70	46	3	1	73	08
x	ii	60	18	x	ii	62	49
1	3	50	49	1	3	51	55
2	2	40	41	2	2	41	38
3	1	30	24	3	1	31	49
xi	i	22	19	xi	i	23	16
1	3	15	15	1	3	15	56
2	2	09	16	2	2	09	38
3	1	04	12	3	1	04	26
xii		00	00	xii		00	00
1	3	03	56	1	3	04	03
2	2	07	14	2	2	07	23
3	1	10	09	3	1	10	19
i	xi	12	43	i	xi	12	54
1	3	15	02	1	3	15	14
2	2	17	10	2	2	17	26
3	1	19	06	3	1	19	41
ii	x	20	53	ii	x	21	07
1	3	22	36	1	3	22	44

Declining 55 Deg.				Declining 56 Deg.			
2	2	24	13	2	2	24	17
3	1	25	44	3	1	25	56
iii	ix	27	13	iii	ix	27	24
1	3	28	36	1	3	28	41
2	2	30	00	2	2	30	02
3	1	31	21	3	1	31	02
iiii	viii	32	40	iiii	viii	32	43
1	3	34	00	1	3	33	58
2	2	35	20	2	2	35	17
3	1	36	41	3	1	36	36
v	vii	38	08	v	vii	37	57
1	3	39	32	1	3	39	19
2	2	41	03	2	2	40	46
3	1	42	32	3	1	43	14
	vi	44	11		vi	43	48
1	3	45	57	1	3	45	33
2	2	47	44	2	2	47	14
3	1	49	44	3	1	49	09
vii	v	51	56	vii	v	51	16
1	3	54	22	1	3	53	34
2	2	57	07	2	2	56	07
3	1	60	08	3	1	9	01
viii	iiii	63	30	viii	iiii	62	18

South Declin. 57 00			South Declin. 58 00		
Subst. distance 33 42			Subst. distance 34 00		
Stiles Height 19 49			Stiles Height 19 16		

Hours.		d.	m.	Hours.		d.	m.
2	2	85	16	2	2	88	10
3	1	75	42	3	1	79	18
x	ii	65	13	x	ii	68	38
1	3	54	14	1	3	57	23
2	2	43	16	2	2	45	08
3	1	33	05	3	1	35	10
xi	i	24	08	xi	i	26	20
1	3	16	28	1	3	17	40
2	2	09	58	2	2	10	20
3	1	04	30	3	1	04	29
xii		00	00	xii		00	08
1	3	04	14	1	3	04	10
2	2	07	27	2	2	07	40
3	1	10	32	3	1	10	46
i	xi	13	09	i	xi	13	21
1	3	15	26	1	3	15	37
2	2	17	33	2	2	17	47
3	1	19	27	3	1	19	43
ii	x	21	21	ii	x	21	30
1	3	23	00	1	3	23	04
2	2	24	32	2	2	24	42
3	1	26	07	3	1	26	11
iii	ix	27	34	iii	ix	27	34
1	3	28	57	1	3	28	56
2	2	30	09	2	2	30	14

Declining 59 Deg.				Declining 60 Deg			
2	2	47	11	3	1	38	07
3	1	36	05	xi	i	27	20
xi	i	26	13	1	3	17	37
I	3	17	42	2	1	11	02
2	2	10	41	3	1	04	53
3	1	04	42		xii	00	00
	xii	00	00	I	3	04	25
I	3	04	21	2	2	08	06
2	2	07	45	3	1	11	10
3	1	10	35	i	xi	13	53
i	xi	13	37	I	3	16	13
I	3	15	15	2	2	18	22
2	2	18	05	3	1	20	17
3	1	20	02	ii	x	22	02
ii	x	21	45	I	3	23	47
I	3	23	22	2	2	25	09
2	2	24	55	3	1	26	35
3	1	26	20	iii	ix	27	54
iii	ix	27	35	I	3	29	10
I	3	29	00	2	2	30	26
2	2	30	50	3	1	31	38
3	1	31	17	iiii	viii	33	50
iiii	viii	32	44	I	3	34	00
I	3	33	56	2	2	35	07
2	2	35	07	3	1	35	58
3	1	36	20	V	vii	37	29
V	vii	37	34	I	3	38	41
I	3	38	48	2	2	39	56
2	2	39	05	3	1	41	13

Declining 57 Deg				Declining 58 Deg.			
3	1	31	24	3	1	31	29
ii.i	viii	32	40	iiii	viii	32	44
1	3	33	56	1	3	33	58
2	2	34	47	2	2	35	10
3	1	36	29	3	1	36	25
V	vii	37	48	V	vii	37	41
1	3	39	08	1	3	38	58
2	2	40	31	2	2	40	20
3	1	41	57	3	1	41	43
	vi	43	26		vi	43	10
1	5	45	04	1	3	44	43
2	2	46	50	2	2	46	22
3	1	48	39	3	1	48	08
vii	v	50	17	vii	v	50	03
1	3	52	52	1	3	52	08
2	2	55	20	2	2	54	30
3	1	58	04	3	1	57	10
viii	iiii	61	12	viii	iiii	60	11

South Declin. 59 00	South Declin. 60 00
Subst. distance 34 15	Subst. distance 34 33
Stiles Height 18 42	Stiles Height 18 06

Hours.		d.	m.	Hours.		d.	m.
2	2	89	00	3	1	84	47
3	1	79	47	x	li	74	07
x	ii	70	25	1	3	62	43
1	3	59	52	2	2	49	42

Declining 59 Deg.			Declining 60 Deg.		
3	I	41	25	vi	42	35
	vi	42	50	I	3	43	59
I	5	44	18	2	2	45	20
2	2	45	52	3	1	47	09
3	I	47	33	vii	v	48	53
vii	v	49	24	I	3	50	48
I	3	51	25	2	20	52	55
2	2	53	38	3	I	55	18
3	I	55	11	viii	iiii	57	10
viii	iiii	59	01			

A Table shewing the Plain's Difference of Longitude for every Degree of Declination, in the Latitude of 51 deg. min. 30.

Decli.	d.	m.	Decli.	d.	m.	Decli.	d.	m.
01	01	17	07	08	55	13	16	26
02	01	33	08	10	11	14	17	40
03	03	49	09	11	27	15	18	54
04	05	07	10	12	42	16	20	07
05	06	23	11	13	57	17	21	20
06	07	39	12	15	10	18	22	33

The Table of the Plain's Difference of Longitude continued.

Decli.	d.	m.	Decli.	d.	m.	Decli.	d.	m.
19	23	45	43	50	00	67	71	38
20	24	57	44	50	59	68	72	27
21	26	08	45	51	57	69	73	16
22	27	18	46	52	55	70	74	06
23	28	39	47	53	53	71	74	55
24	29	38	48	54	50	72	75	44
25	30	47	49	55	46	73	76	33
26	31	56	50	56	42	74	77	21
27	33	04	51	57	38	75	78	09
28	34	12	52	58	33	76	78	57
29	35	19	53	59	28	77	79	46
30	36	25	54	60	23	78	80	33
31	37	31	55	61	17	79	81	21
32	38	36	56	62	10	80	82	09
33	39	41	57	63	04	81	82	56
34	40	46	58	63	57	82	83	43
35	41	49	59	64	49	83	84	31
36	42	52	60	65	41	84	85	18
37	43	55	61	66	33	85	86	05
38	44	58	62	67	24	86	86	52
39	45	59	63	68	16	87	87	39
40	47	00	64	69	07	88	88	26
41	48	00	65	69	57	89	89	13
42	49	00	66	70	47	90	90	00

The Use of the foregoing Tables.

CHAP· XII.

The Ufe of the TABLES

SECTION I.

The Geometrical Conftruction of a South Eaft and South Weft Plain, **Declining** 25 *Deg.*

Firft, draw the Horizontal Line A B, (as in fig. D & E)and from the middle of the line A B let fall the Perpendicular C D, for the Meridi= an or Hour line of 12. Then with 60 Deg. of Chords, making C the Center, defcribe with your Compaffes the Semicircle A E B.

Then turn to Page 24 of the Tables, in it you'l find South **Declining** 25 *Deg.* Then from the fame line of Chords you defcribed your Se= micircle with, work as followeth : Take off 73 deg. 10 min. which ftands againft viii and iiii, the firft *Hours* in your Table, and fet from the Meridian line on your Semicircle from E towards A, in the Weft Decliner, and from E towards B, in the Eaft Decliner for the *Hours* of vii in the Morning in the Weft Decliner, and iiii in the Afternoon on the Eaft Decliner. Then take 47 deg. 12 min. for ix in the Weft decliner, and iii in the Eaft decliner ; & 11 deg 30 min. for xi in the Weft decliner, and i, on the Eaft decliner, fo you have the Hour-Points for the

Morning

Morning in the West decliner, and the After-
noon Hours in the East decliner.

Then take	D.	M.				
	09	34	And set	1	And from	11
	18	35	from E to	2	E towards	10
	26	45	wards B,	3	A, for the	9
	36	08	on the W.	4	Hour-Poi.	8
	47	24	Decliner,	5	on the Ea.	7
	62	05	for the H	6	Decliner,	6
	82	01	Points of	7	Viz.	5

(Afternoon.) *(Morning.)*

Thus you have Hour-Points for the East and
West Decliner. Then lay a Ruler to C the Cen-
tre of each Dial, and through the respective points
made in the Semicircle, draw lines, you have all
the Hour-Lines of South Plain Declining East
and West 25 Degrees.

Lastly take from your line of Chords, 18 deg.
37 min. the Substile's distance from the Meri-
dian, and set on the Semicircle from E to S, on
both Dials, and draw the line C S, for the Sub-
stile, and take 34 deg. 21 min. and set from S
to P, for the Stiles Height, and draw C P, and
you have the Stile, which may be either a Plate
or Wire brought to such an Angle, and must
stand Perpendicular to the Plain, and directly
ver the Substilar C S.

Th

Fig 9

Fig E
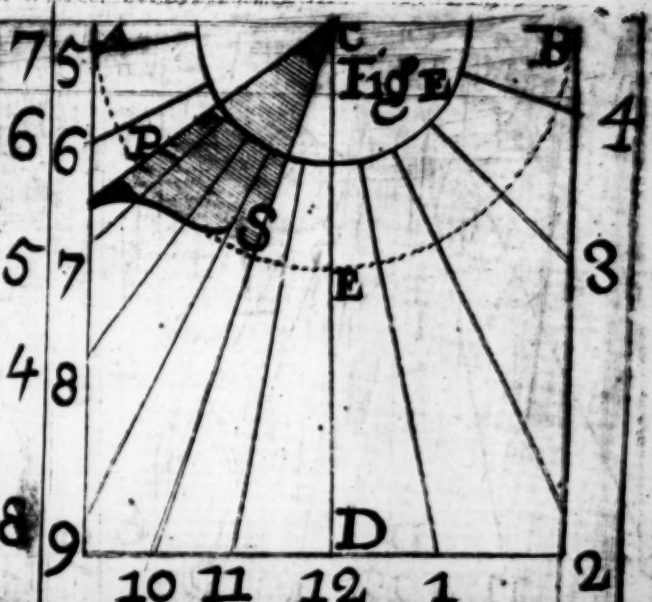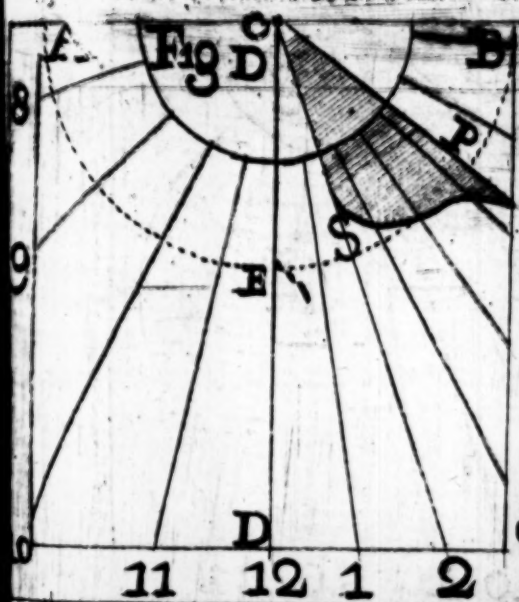
Thus you have finished your Dials. If you
defire to infert the Quarters, Half Hours, and
Three Quarters, on the Dial, take them from
the Table, and fet them on your Dial from the
Meridian by the fame line of Chords you made
ufe of for the Hours and you'l have your dlire.

Note. If the Declination be Eaft, the Subftile
muft be placed on the left fide of the Meridian,
and thofe Hours that are next to the deg. and
min. in your Table muft be ufed : but the con-
trary if your Plairls Declination be Weft.

Now you have finiſhed your Dials and in fo
doing you have made two North Decliners, as
you may fee by Page 31 before the Tables.

And in the fame Page, you have directions
for finding the time the Sun forſaketh one fide of
a declining Plain to fhine upon the other.

How to draw the hour lines on Far Declining
Dials is Taught in Page 37 before the Tables
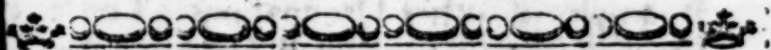
Advice to Diallifts.

IT is Ufual among Diallifts, when
they draw Dials upon a Cube, to
draw South and North Decliners in-
ftead of the Four Erect Dials : And to
draw the Hour-lines of the Morning on the
Souht-weft decliner, and the Afternoon Hours
on the South-Eaft decliner ; and the hours before
Sun rifing, and after Sun fetting on the North
Decliners

decli er, which Hours are needless ; but if the
like the Decliners better than the Erect Dial
it is better to leave out the Morning Hours o
the South West decliner, and the Afternoo
hours on the South East decliner ; because th
Forenoon hours on the South East decliner, an
the Afteenoon on the South West decliner, shew
all the hours from Sun-rising till Sun-setting

When I draw the Decliners upon a Cube,
place the Meridian of the South West decline
near the Left side of the Plain, and the Merid
an of the South West decliner near the Rig
side, by which means the hour lines will be f
ther from one another. And the Midnig
Meridian of the North West decliner near th
Right side of the Plain, and the Meridian of t
North East near the Left side.

Thus haveing given you the Use of the
Tables in the drawing a Dial Declining 25
grees, I think it needless to give any m
Examples of other Declinations : For let y
Declination be what it will under 60 deg. i
but turning to it in the T A B L E S, and
ing the degrees and minutes belonging to t
Hours, from the Meridian, and drawing li
from the Centre, and you have your desire.

SE

Fig. F

Lat 51:30
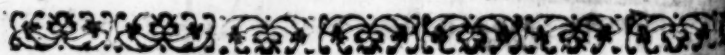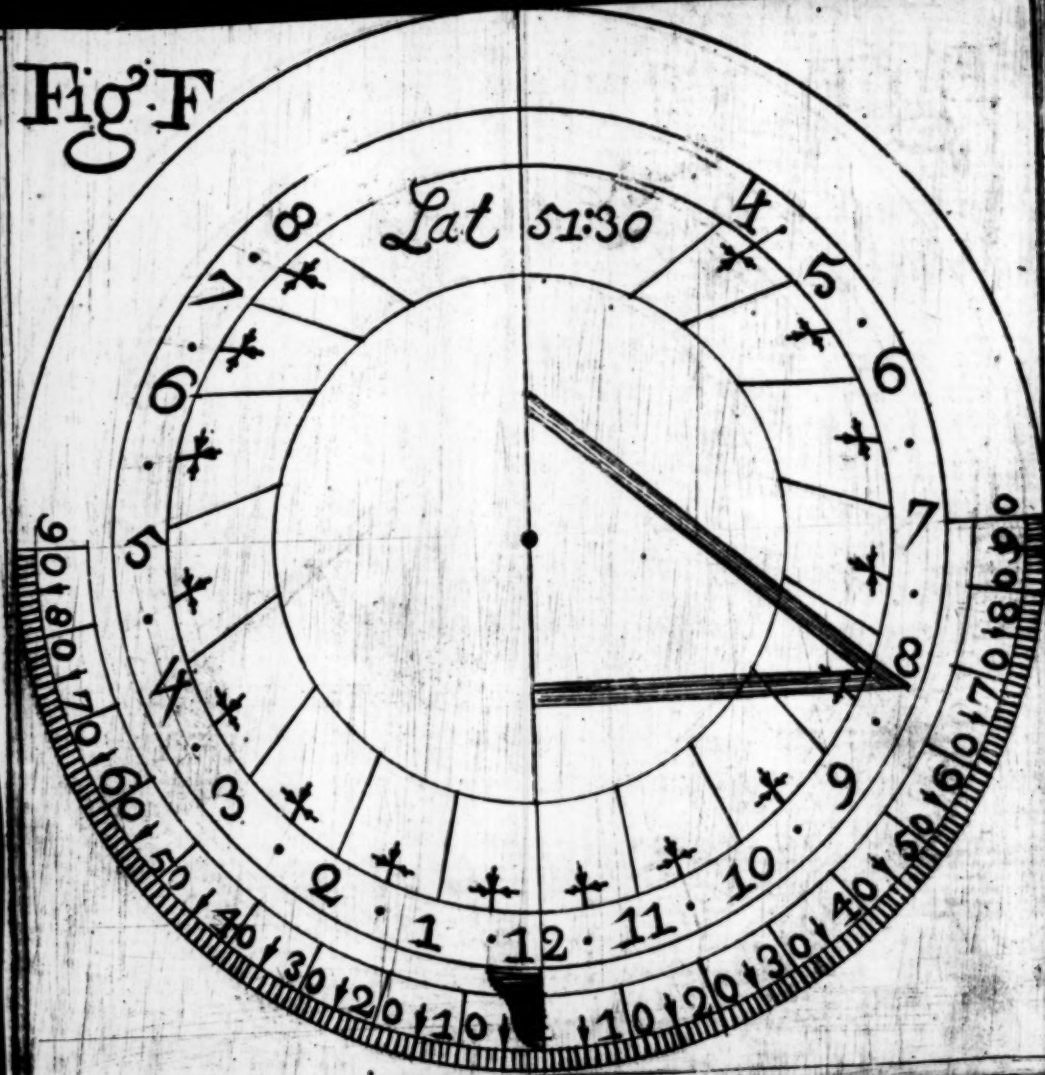
SECTION II.

How to find the Declination of any Plain is taught in CHAP. the VIII th. It being the Common way given by many Authors; but the way that I use is as followeth.

GET a large square piece of Brass or Wood, and draw on it a Circle, which divide into four parts, perpendicular to each side of the square then let one half of the Circle be divided into 180 deg. and numbred with 10, 20, 30, 40 50, 60 70, 80, and 90, each way from the Perpendicular ; on the Centre of the Semicircle moves an Horizontal Dial, properly made for the Latitude of the Place, and which hath a small bit of fine Brass fix'd on its Meridian Line, like a fiducial Edge, to cut the Degrees in the Semicircle.

The use of which is very easy ; for at any time when the Sun shines, you need only apply that side of the square to the Plain where the Degrees begin to to be Number'd from, and then setting it as nearly as you can Horozontally, turn the Dial about, till it shews exactly the true Hour of the Day, (which before must be rightly found, and a Watch set to it) and then will the Fiducial Edge cut the Deg. of the Plains Declination; and which way to account it, will be easily seen, because the Dial pointing true North, gives you an Idea of all the Points of the Compass.

See fig. F.   And

And this Method will be of great use to such whose Business it is to make many Dials in or near the same Latitude.

SECTION III.

To place an Horizontal Dial, made for the Latitude of **London** (51 : 30) in any other Latitude, so as to shew the true *Hour* of the Day, as well as tho' it was made the Latitude placed in.

IF you live in London, and have an Horizontal Dial made for that Latitude, and you remov your Dial to another place that lieth more Northwad, or Southward, East ward or Westward mnketh no alteration) you must not place your Dial Horizontally as before but Observe these Rules following.

RULE I.

Suppose you Remove your Dial Northward that is to a greater Latitude, Admit, to New-castle upon Tine, whole Latitude is 54 : 58, Subtract the one from the other, and note the Difference.

Newcastle   54 : 58.
London   51 : 30

—————————————
Difference   03 : 28

Elevate the North side of your Dial, equal to the difference 03 : 28, so will your Dial be placed in such a Situation, as it will shew the True time of the Day.

RULE II.

Admit you Remove your Dial Southward, that is to a lesser Latitude, as suppose to Paris in France, whose Latitude is 48 : 39, Subtract the one from the other and note the difference.

	D.	M.
London	51 :	30
Paris	48 :	39

The Difference 02 : 51.

Elevate the South side of your Dial equal to the difference 02 : 51, and your Dial is placed in its Proper Latitude.

The DEMONSTRATION of these two RULES.

Observed in Newcastle upon Tine, a Sun Dial, whose North side was Elevated above the Horizon 03 deg. 28 min. the owner told me it was an Horizontal Dial made for some other Latitude, Viz. London, and was so placed by a Diallist as to shew the true time of the day.

He desired me to Prove by the Rules of Dialling that it was made for London, which I did as followeth.

The Latitude of Newcastle is 54 deg. 58 m. Complement is 35 deg. 02 min. the Plains

Declination

Reclination in that Latitude is the Compl[m]
of its Elevation above the Horizon, viz. 86 [..]
32 min. and is a Direct South Recliner, gre[...]
than the Complement the Latitude, which [...]
the first Sect. of the XI th. Chap. in Page [...]
before the Tables, is thus Proved.

Example.

Plains Reclination ——— 86 : 32
Complement of the Lat. 35 : 02
————————————
Remains the Lat. requ. 51 : 30

Again, admit you are at Paris in Fra[nce]
and see an Horizontal Dial Elevated on [..]
South side 02 deg. 51 min. In what Lati[..]
is it an Horizontal Dial?

The Latitude of Paris is 48 deg. 39 m[..]
the Complement is 41 deg. 21 min. the R[..]
nation in that Latitude is the Complement [..]
its Elevation above the Horizon viz. 87 : [..]
and it is a Direct North Dial. Reclining gr[..]
than the Complement of the Latitude, wh[..]
by Sect. II. in Page 43 before the Tables, [..]
Horizontal Dial for London. viz. 51 : 3[..]

Example.

Plains Reclination ——— 78 : 09
Complement of the Lat. 41 : 21
————————————
The Sum ——— 128 : 30 Sub[..]
from 180 deg. the remainder is 51 : 30 the [..]
titude required,

FINIS.